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ABSTRACT

This curriculum for a 1-semester or 1-year course in manufacturing is designed to give students experience in applying knowledge from other courses and some basic production skills as they become involved in a manufacturing enterprise. Course content is organized around the laboratory activities necessary to organize and operate a process to mass produce and market a product. The following topics are covered: manufacturing overview, personnel, product design, marketing, finance, plant engineering, materials management, manufacturing engineering, quality control, production control, and methods engineering. The guide contains competencies (task lists), student competency records, and management sheets. Management sheets, which serve as lesson outlines covering 1 or more days, include the following: an introduction, the performance objective, a task/competency statement; an equipment and supplies list, a performance standard, suggested references for teacher and student; activities; and the evaluation criteria. Appendixes have the following contents: course outline; job description form; job application; employee records; problem-solving model; types of research; survey forms; sources of financing; basic safety rules; types of plant layout; policies and procedures; tooling design sheet; quality control information; methods engineer job description; definitions; lists of tools, equipment, and supplies; a facility layout; and a bibliography listing 16 books and 8 audiovisual resources. (KC)

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CURRICULUM GUIDE

FOR

TECHNOLOGY EDUCATION

MANUFACTURING SYSTEMS

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Office of Vocational Education

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1988

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MANUFACTURING SYSTEMS

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MANUFACTURING SYSTEM

RATIONALE

Throughout history, people have produced goods and provided services. These activities continue to be important, but changes are coming at a faster rate. Automation allows goods to be produced faster, cheaper, and safer. Machines eliminate many dangerous and tedious tasks. Production technology is a major cause of social change. New work skills are needed as old skills are eliminated. New production processes often require new raw materials. Introducing robotics into industry has created an enormous impact. Combining these robotics with computers (artificial intelligence) will greatly affect the work that people do. As new technology affects production systems, lifestyles also will change. A positive result of automation is the increase in productivity, decrease in cost, and less worker fatigue.

Since the educational system should provide courses of study conducive to developing a person's understanding of the world about him/her, a study of manufacturing as a system becomes a valid and significant part of their plan of study. Through activities which employ a wide range of tools and materials in conjunction with extensive planning and processing skill used in industry, many students will have the opportunity to understand some of the careers available to them for further pursuit.

In summary, changes in production are occurring at a faster and faster rate and the pace will not decrease. Our students will be living and working in this highly technical, highly competitive, rapidly changing world and we must prepare them to deal with these changes and make decisions about some of the problems of the future.

CURRICULUM RELATIONSHIP TO OTHERS

A technology-based curriculum is significantly different from the traditional approach to industrial arts. Students who have backgrounds in science and business courses may find this to be challenging, to say the least, and should be encouraged to use those skills in this course. Also, the females, who have shied away from industrial arts classes, should be encouraged to get involved with decision making and looking at some career opportunities in a highly paid and fast growing field of manufacturing. The aspect of women and minorities in management is a fact of technology of today. This curriculum uses computers, business accounting, marketing, and problem-solving models to develop and mass produce products with potential of selling them at a profit.

SAFETY

Safety is always a consideration when using tools and materials. While teaching a course in Manufacturing Systems, the instructor should emphasize safety at all times. The activities are laboratory based, hands-on, and require the use of tools.

Safety has been considered in each activity presented in this curriculum guide. It is recommended that the instructor incorporate Task/Competency # MAS-034 into the early planning of the course.

ORGANIZATION OF THE CURRICULUM

The material of Manufacturing Systems topic is divided into Eleven areas: (1) Manufacturing Overview; (2) Personnel (3) Product Design; (4) Marketing; (5) Finance; (6) Plant Engineering; (7) Materials Manager; (8) Manufacturing Engineer; (9) Quality Control; (10) Production Control; (11) Methods Engineering.

Each functional area consists of the following:

A) A series of Performance Objectives which outline the Task/Competency to be accomplished, the conditions or needs which must be available to obtain a standard of performance that is established.

B) Reference Section which describes recommended materials to read and suggested materials to help students get a better understanding of the subject.

C) Activity Section which describes a list of activities for instructor's consideration. These activities relate to the performance objective stated for each management sheet.

Each reference section and activity section is subdivided into two parts (1) Teacher section and (2) the Student section.

FOOTNOTE: The competencies marked with asterisks must be taught in an 18-week course. (All competencies must be taught for a 36-week course.)

INTRODUCTION TO THE CURRICULUM

The Manufacturing Systems Curriculum is designed to give the students experience in applying knowledge from other courses and some basic production skills. The elements of business and industry are directly applied by the students as they become actively involved in a manufacturing enterprise. Emphasis is placed on (1) production management, (2) efficient and appropriate plant layouts, (3) process selection and sequencing, (4) materials handling system design, (5) quality control procedures, (6) production planning and control activities, (7) work measurement practices, and (8) product manufacturing. The content of the course is entirely oriented around the laboratory activities necessary to organize and operate an enterprise which will mass produce a product and market that product. This course is offered for 18 or 36 weeks at the secondary level.

GENERAL OBJECTIVES

1) To GAIN KNOWLEDGE and COMPREHENSION of the various functional areas and the function they serve within an enterprise.

2) To COMPREHEND the interrelationships of the various functional areas to each other, and the enterprise as a whole.

3) APPLICATION of problem-solving techniques to a variety of problems as they exist in the operation of an enterprise.

4) APPLICATION of management by planning, developing, directing, and controlling.

5) DEVELOP a degree of skill in working and cooperating as a team to successfully complete a project.

6) DEVELOP a degree of skill in planning, developing, organizing production, and methods of production.

7) DEVELOP a degree of skill in the application of the computer within each enterprise position.

HELPFUL HINTS

1. START PLANNING EARLY !!!!
2. Review the whole curriculum.
3. Review the competency list to be achieved.
4. Do the overview section as a whole class.
5. Assign or select students into groups as soon as possible.
6. Do different activities for groups at the same time if possible.
   (This allows for more production time if needed).
7. THINK SAFETY AT ALL TIMES.

MANUFACTURING SYSTEMS

COMPETENCIES

DUTY: MANUFACTURING OVERVIEW

*MAS-001. Name and describe the three types of production associated with manufacturing.

MAS-002. Describe the major factors that occurred in the history of manufacturing.

MAS-003. Define the common terminology associated with an industrial enterprise.

*MAS-004. List and describe the various careers that are available in manufacturing.

*MAS-005. Identify three essentials that compose the manufacturing system.

MAS-006. Assess the effects that manufacturing may have upon the society.

*MAS-007. Select the company officers and managers.

DUTY: PERSONNEL MANAGER'S FUNCTION

*MAS-008. Complete the contents of a job description and job specification

*MAS-009. Distinquish the different types of organizational structures.

*MAS-010. Complete a job application form.

MAS-011. Develop a list of steps required in the hiring process.

MAS-012. Develop a system to keep accurate employee records.

*MAS-013. Define the terminology and functions associated with a personnel manager.

COMPETENCIES

DUTY: PRODUCT DESIGN

*MAS-014. Apply the problem-solving Model.

MAS-015. Identify the three major kinds of research and development that take place in industry.

MAS-016. List at least five sources of product design ideas.

MAS-017. List and describe the three factors of product design.

*MAS-018. Select the product/products to be prototyped.

*MAS-019. Develop a three-dimensional mock-up or prototype of a product.

DUTY: MARKETING MANAGER'S FUNCTION

*MAS-020. List and describe the major elements of marketing.

*MAS-021. Conduct a market research study.

MAS-022. Complete a marketing policy and procedures document.

*MAS-023. List and describe the elements of a sales campaign.

MAS-024. Describe the functions of advertising.

*MAS-025. List and describe the five functions of a package.

MAS-026. List and describe the methods for distributing a product.

DUTY: FINANCIAL MANAGER'S FUNCTION

MAS-027. Describe types of company ownership available to industry.

*MAS-028. Select your student enterprise ownership type.

DUTY: FINANCIAL MANAGER'S FUNCTION

MAS-029. Develop sources of financing and "cash flow" for your company.

*MAS-030. Define the types of cost associated with operating a company.

MAS-031. Define the terminology and functions used for break-even analysis.

*MAS-032. Complete a break-even graph and analysis for the company.

MAS-033. Define the terminology and describe the basic format associated with general financial statements.

DUTY: PLANT ENGINEER'S FUNCTION

*MAS-034. Complete a safety awareness program.

MAS-035. List and describe four types of plant layout.

MAS-036. Identify and list methods of moving parts and products around the manufacturing plant.

DUTY: MATERIALS MANAGER'S FUNCTION

MAS-037. Utilize a Materials Requirements Planning concept.

MAS-038. Develop a list of sources/suppliers of raw material and component parts.

*MAS-039. Complete a typical purchase requisition form for raw material or parts.

*MAS-040. Complete a purchase order that would be used to order parts.

MAS-041. Complete a typical purchasing procedures document for the company.

COMPETENCIES

DUTY: MANUFACTURING MANAGER'S FUNCTION

*MAS-042. List the three major considerations when designing tooling.

*MAS-043. Define the terminology associated with tooling, jigs, and fixtures.

MAS-044. Make a list of all machine processes available in the school.

*MAS-045. Use a jig and fixture design sheet.

DUTY: QUALITY CONTROL MANAGER'S FUNCTION

*MAS-046. Define the terminology associated with Quality Control.

MAS-047. Identify the distinct steps in a quality control program.

*MAS-048. Develop a quality control work order for inspections.

*MAS-049. Perform the inspections required to meet customer demands and make a quality product.

DUTY: PRODUCTION CONTROL MANAGER'S FUNCTION

*MAS-050. List and define the terminology associated with production control.

MAS-051. Develop a timetable of scheduled events that must take place to have a successful enterprise.

*MAS-052. Develop an order/routing sheet.

*MAS-053. Develop a flow process chart of the production process.

DUTY: METHODS ENGINEER'S FUNCTION

*MAS-054. List and define the terminology associated with Methods and Work Measurement.

*MAS-055. Develop work station designs for the enterprise.

DUTY: METHODS ENGINEER'S FUNCTION

MAS-056. List and describe the steps needed to perform a direct stopwatch time study.

MAS-057. Perform a direct stopwatch time study on operations in the lab.

STUDENT COMPETENCY RECORD

School _____
Student _____

School Year _____
Instructor's Name _____
Course Title Manufacturing Systems
Classification _____

Student Address _____
_____ _____
Zip

Comments _____
_____
_____
_____
_____

The student should be evaluated according to the performance ratings listed. Indicate on this form the numeric rating of the student's performance for each item.
(1) Competency in Process
(2) Competency Performed with Close Supervision
(3) Competency Performed with Limited Supervision
(4) Competency Performed without Supervision

COMPETENCIES

	MAS-001.	Name and describe the three types of production associated with manufacturing.
	MAS-002.	Describe the major factors that occurred in the history of manufacturing.
	MAS-003.	Define the common terminology associated with an industrial enterprise.
	MAS-004.	List and describe the various careers that are available in manufacturing.
	MAS-005.	Identify three essentials that compose the manufacturing system.
	MAS-006.	Assess the effects that manufacturing may have upon the society.
	MAS-007.	Select the company officers and managers.
	MAS-008.	Complete the contents of a job description and job specification.
	MAS-009.	Distinquish the different types of organizational structures.
	MAS-010.	Complete a job application form.
	MAS-011.	Develop a list of steps required in the hiring process.
	MAS-012.	Develop a system to keep accurate employee records.
	MAS-013.	Define the terminology and functions associated with a personnel manager.
	MAS-014.	Apply the problem-solving Model.
	MAS-015.	Identify the three major kinds of research and development that take place in industry.

	MAS-016.	List at least five sources of product design ideas.
	MAS-017.	List and describe the three factors of product design.
	MAS-018.	Select the product/products to be prototyped.
	MAS-019.	Develop a three-dimensional mock-up or prototype of a product.
	MAS-020.	List and describe the major elements of marketing.
	MAS-021.	Conduct a market research study.
	MAS-022.	Complete a marketing policy and procedures document.
	MAS-023.	List and describe the elements of a sales campaign.
	MAS-024.	Describe the functions of advertising.
	MAS-025.	List and describe the five functions of a package.
	MAS-026.	List and describe the methods for distributing a product.
	MAS-027.	Describe types of company ownership available to industry.
	MAS-028.	Select your student enterprise ownership type.
	MAS-029.	Develop sources of financing and "cash flow" for your company.
	MAS-030.	Define the types of cost associated with operating a company.

	MAS-031.	Define the terminology and functions used for break-even analysis.
	MAS-032.	Complete a break-even graph and analysis for the company.
	MAS-033.	Define the terminology and describe the basic format associated with general financial statements.
	MAS-034.	Complete a safety awareness program.
	MAS-035.	List and describe four types of plant layout.
	MAS-036.	Identify and list methods of moving parts and products around the manufacturing plant.
	MAS-037.	Utilize a materials requirements planning concept.
	MAS-038.	Develop a list of sources/suppliers of raw material and component parts.
	MAS-039.	Complete a typical purchase requisition form for raw material or parts.
	MAS-040.	Complete a purchase order that would be used to order parts.
	MAS-041.	Complete a typical purchasing procedures document for the company.
	MAS-042.	List the three major considerations when designing tooling.
	MAS-043.	Define the terminology associated with tooling, jigs, and fixtures.
	MAS-044.	Make a list of all machine processes available in the school.
	MAS-045.	Use a jig and fixture design sheet.
	MAS-046.	Define the terminology associated with Quality Control.
	MAS-047.	Identify the distinct steps in a quality control program.
	MAS-048.	Develop a quality control work order for inspections.
	MAS-049.	Perform the inspections required to meet customer demands and make a quality product.
	MAS-050.	List and define the terminology associated with production control.
	MAS-051.	Develop a timetable of scheduled events that must take place to have a successful enterprise.

	MAS-052.	Develop an order/routing sheet.
	MAS-053.	Develop a flow process chart of the production process.
	MAS-054.	List and define the terminology associated with Methods and Work Measurement.
	MAS-055.	Develop work station designs for the enterprise.
	MAS-056.	List and describe the steps needed to perform a direct stopwatch time study.
	MAS-057.	Perform a direct stopwatch time study on operations in the lab.

MANAGEMENT SHEETS

PERFORMANCE OBJECTIVE (Suggested Time: 2 - 3 Days)

* TASK/COMPETENCY: (001). Name and describe the three types of production associated with manufacturing.

CONDITIONS: Students will be given a list of examples from industry.

STANDARD OF PERFORMANCE: Match each example to the proper type of production within 75 percent accuracy.

REFERENCES

TEACHER	STUDENT
1. Recommended a. Exploring Manufacturing, Choosing a Manufacturing System. Chapter 20, Pages 163-167. 2. Suggested a. Manufacturing, a basic text, What is Manufacturing? Chapter 1, Pages 14-25. b. Basic Manufacturing, The Manufacturing Enterprise. Chapter 2, Pages 19-20.	1. Recommended a. Exploring Manufacturing, Choosing a Manufacturing System. Chapter 20, Pages 163-67.

ACTIVITIES

TEACHER	STUDENT
1. Have students read the topic: Types of Production in recommended text.	1. Read the topic: Types of Production in recommended text.
2. Give examples of the different types and how each is distinctive from each other.	2. As a member of a group, actively take part in the decisions of the group.
3. Hand out a list of different products.	3. Given a list of product examples, determine the proper or best way to produce that particular product.
4. Place students into groups of 4-5 people and have them determine what type of production would be the best for each product.	

PERFORMANCE OBJECTIVE (Suggested Time: 1 - 2 Days)

TASK/COMPETENCY: (002). Describe the major factors that occurred in the history of manufacturing.

CONDITIONS: Students will be given a performance test.

STANDARD OF PERFORMANCE: List and describe with 75 percent accuracy the major factors of manufacturing in history.

REFERENCES

TEACHER	STUDENT
1. Recommended	1. Recommended
a. Exploring Manufacturing, Development of Manufacturing. Chapter 33, Pages 253-56.	a. Exploring Manufacturing, Development of Manufacturing. Chapter 33, Pages 253-56.
2. Suggested	2. Suggested
a. Basic Manufacturing, What is Manufacturing? Chapter 1, Pages 14-25.	a. Basic Manufacturing, What is Manufacturing? Chapter 1, Pages 14-25.
b. Manufacturing, a basic text; The Development of Manufacturing.	b. Manufacturing, a basic text, The Development of Manufacturing.

SELECTED AUDIOVISUAL MATERIALS

Movie: Man and the "Second" Industrial Revolution.

ACTIVITIES

TEACHER	STUDENT
1. Have the student read the topic: History of Manufacturing in recommended text. 2. Read chapter 2 of Manufacturing, a basic text. 3. Lead a brief discussion about the contributions of the following people: a. Frederick Taylor b. Lillian Gilbreath c. Henry Ford d. Many others 4. Arrange a field trip to a local manufacturing company to observe production methods. 5. A brief discussion about the field trip and how these production methods may have evolved through time. 6. Discuss with students what their lives would be like if they worked in a factory 10 to 14 hours a day.	1. Read topic: History of Manufacturing in recommended text. 2. Participate in a class discussion which will deal with old and modern production methods. 3. Participate in a field trip to a local manufacturing company. 4. Take a performance test and score 75 percent or better.

PERFORMANCE OBJECTIVE (Suggested Time: 1 - 2 Days)

TASK/COMPETENCY: (003). Define the common terminology associated with an industrial enterprise.

CONDITIONS: Students wil be given a list of terms or meanings.

STANDARD OF PERFORMANCE: Properly match the terms with meanings with 75 percent accuracy.

REFERENCES

TEACHER	STUDENT
1. Recommended a. Exploring Manufacturing, Development of Manufacturing. Chapter 33, Pages 253-56. Chapter 20, Pages 163-67. 2. Suggested a. Manufacturing, a basic text, Introductory Materials. b. Basic Manufacturing, Introductory Material.	1. Recommended a. Exploring Manufacturing, Development of Manufacturing. Chapter 33, Pages 253-56. Chapter 20, Pages 163-67.

ACTIVITIES

TEACHER	STUDENT
1. Have students review terminology discussed in the introductory material.	1. Review the list of terms and definitions from the introduction.
2. Give a performance quiz on a select number of terms from a list.	2. Take a performance test on a select number of those terms and complete with 75 percent accuracy.

MANUFACTURING OVERVIEW

PERFORMANCE OBJECTIVE (Suggested Time: 1 - 2 Days)

* TASK/COMPETENCY: (004). List and briefly describe various careers available in manufacturing.

CONDITIONS: Students will be given reference materials.

STANDARD OF PERFORMANCE: Provide a list of at least 12 careers available in manufacturing.

REFERENCES

TEACHER	STUDENT
1. Recommended a. Exploring Manufacturing, Careers in Manufacturing. Chapter 35, Pages 262-69. 2. Suggested a. Manufacturing, a basic text, Future in Manufacturing. b. Basic Manufacturing, Careers in Manufacturing. Chapter 12, Pages 139-147.	1. Recommended a. Exploring Manufacturing, Careers in Manufacturing. Chapter 35, Pages 262-69.

SELECTED AUDIOVISUAL MATERIALS

Movie: Career Goals.

ACTIVITIES

TEACHER	STUDENT
1. Have students read the topic: Careers in Manufacturing in recommended text.	1. Read the topic: Careers in Manufacturing in recommended text.
2. Have an informal discussion on why you chose your career in teaching.	2. Ask questions during discussion period of how and why choose a career path so early in life.
3. Have students review some job titles. What do these people do briefly?	3. Review the job titles at the end of Chapter 35 and be able to discuss.
4. Have the students list at least 12 jobs in manufacturing they may have an interest in and tell why that particular career.	4. Make a list of at least 12 job/careers in manufacturing that may have interest to you and rank them in order of importance most to least.
5. Send students to library to find the Occupational Handbook for more details on job titles.	5. Research the library for an Occupational Handbook for more job titles and careers.

PERFORMANCE OBJECTIVE (Suggested Time: 1 - 2 Days)

* TASK/COMPETENCY: (005). Identify three essentials that compose the manufacturing system.

CONDITIONS: Students will be given examples of systems.

STANDARD OF PERFORMANCE: List the essential components of the examples with 75 percent accuracy.

REFERENCES

TEACHER	STUDENT
1. Recommended a. Exploring Manufacturing, The Manufacturing System. Chapter 2, Pages 14-19. 2. Suggested a. Basic Manufacturing, Essentials of Manufacturing. Introduction, Pages 14-16. b. Exploring Production The Production System.	1. Recommended a. Exploring Manufacturing, The Manufacturing System. Chapter 2, Pages 14-19. 2. Suggested a. Basic Manufacturing, Essentials of Manufacturing. Introduction, Pages 14-16.

SELECTED AUDIOVISUAL MATERIALS

Sound Filmstrips for Manufacturing.

ACTIVITIES

TEACHER	STUDENT
1. Have students read the topic: Manufacturing Systems in recommended text. 2. Also read the topic: Essentials of Manufacturing in the suggested text. 3. Discuss the terminology, and give examples of the three essentials. 4. Form the students into groups. Handout examples of different Human, Natural, and Capital Resources. 5. Have students place each example into one or more of the categories.	1. Read topic: Manufacturing Systems in recommended text. 2. As members of groups you are given examples of essential items for manufacturing. You are to place each example into the proper category (using your own judgement). Also, an item may fit into more than one category. 3. Turn in results to the instructor.

MANUFACTURING OVERVIEW

PERFORMANCE OBJECTIVE (Suggested Time: 1 - 2 Days)

TASK/COMPETENCY: (006). Assess the effects that manufacturing may have upon the society.

CONDITIONS: Students will be given examples of industrial sites.

STANDARD OF PERFORMANCE: List the advantages and disadvantages of each example cited in the society with 70 percent accuracy.

REFERENCES

TEACHER	STUDENT
1. Recommended a. Manufacturing, a basic text, Developments of Manufacturing. Chapter 2, Pages 33-37. 2. Suggested a. Exploring Manufacturing, Manufacturing and the Future. Chapter 34, Pages 257-261.	1. Recommended a. Exploring Manufacturing, Manufacturing and the Future. Chapter 34, Pages 257-261.

SELECTED AUDIOVISUAL MATERIALS

Movie: Industries of the Future

ACTIVITIES

TEACHER	STUDENT
1. Have students read the Topic: Future Developments in recommended text.	1. Read topic: Future Developments in recommended text.
2. Have a discussion about environmental factors, automation, computers, general future trends.	2. Be prepared to discuss topics as: environmental factors, automation, and computers.
3. Have students form groups and list waste materials in the shop that could be recycled or used in another way.	3. Be able to take part in developing a list of waste materials in your shop that could be recycled or used another way.
4. Have students also list some of the environmental factors located in your shop.	4. Also list some environmental factors that could or do affect the school.

PERFORMANCE OBJECTIVE (Suggested Time: 1 - 2 Days)

* TASK/COMPETENCY: (007). Select the company officers and managers.

CONDITIONS: Students will be given a list of names.

STANDARD OF PERFORMANCE: Select with 80 percent accuracy according to their requested positions.

ENABLING OBJECTIVE: Have an understanding of or examine different types of organizational structures, job descriptions, and job applications.

REFERENCES

TEACHER	STUDENT
1. Recommended a. Exploring Manufacturing, Getting Human Resources. Chapter 22, Pages 178-81. 2. Suggested a. Basic Manufacturing, Personnel Management. Chapter 7, Pages 85-97. b. Manufacturing, a basic text, Hiring and Training. Chapter 10, Pages 138-140.	1. Recommended a. Exploring Manufacturing, Getting Human Resources. Chapter 22, Pages 178-81.

ACTIVITIES

TEACHER	STUDENT
1. Have students read topic: Personnel Management in recommended text.	1. Read topic: Personnel Management in recommended text.
2. Review the job preference sheets turned in by students earlier. Develop a list of students for each area of management that will be needed according to their preference.	2. You will be given a selection of names for each position of an organizational chart. You are to vote for the person you feel best qualified for each position.
3. Starting at the top of an organizational structure that was previously decided upon, allow the students to vote on the list on the blackboard for each position.	3. Students are to review job applications and ask questions of possible position holders.
4. Write down the selected names for each position and turn over to the personnel manager.	
5. Make sure students take part in this process. (Employee Involvement)	

PERFORMANCE OBJECTIVE (Suggested Time: 1 - 2 Days)

* TASK/COMPETENCY: (008). Complete the contents of a job description and job qualification/specifications.

CONDITIONS: Students will be given a blank form, and sample job.

STANDARD OF PERFORMANCE: Complete the form with 80 percent accuracy.

REFERENCES

TEACHER	STUDENT
1. Recommended a. APPENDIX "B" Job Description & Job Specifications. b. Basic Manufacturing, Personnel Management. Chapter 7, Pages 85-97. 2. Suggested a. Manufacturing, a basic text, Hiring and Training. Chapter 10, Pages 138-40.	1. Recommended a. APPENDIX "B" Job Description & Job Specifications. 2. Suggested a. Basic Manufacturing, Personnel Management. Chapter 7, Pages 85-97.

SELECTED AUDIOVISUAL MATERIALS

Movie: The Industrial Worker, University of Illinois.

ACTIVITIES

TEACHER	STUDENT
1. Have students read topic: Job Descriptions and Job Qualifications in suggested text. 2. Use Appendix "B" as a reference and distribute to the students. 3. Have students form groups for this activity. 4. Give each group a sample position in management or machine operator. (Each sample should be different) 5. Have each student group write the duties and qualifications needed to perform the sample position.	1. Read topic: Job Descriptions and Job Qualifications in suggested text. Use Appendix "B" as a reference. 2. As a group, write the duties and qualifications needed to perform the sample job position given to your group. 3. Turn the final copy to the instructor for evaluation.

PERFORMANCE OBJECTIVE (Suggested Time: 1 - 2 Days)

* TASK/COMPETENCY: (009). Distinguish the different types of organizational structures.

CONDITIONS: Students will be given a sample company.

STANDARD OF PERFORMANCE: Develop a company structure with 80 percent accuracy according to the evaluation criteria.

REFERENCES

TEACHER	STUDENT
1. Recommended a. Exploring Manufacturing, Organizational Structures. Chapter 16, Pages 137-39.	1. Recommended a. Exploring Manufacturing, Organizational Structures Chapter 16, Pages 137-39.
2. Suggested a. Basic Manufacturing, Managing a Corporation. Chapter 2, Pages 23-28. b. Manufacturing, a basic text, How does a Company Operate? Chapter 8, Pages 110-16.	2. Suggested a. Basic Manufacturing, Managing a Corporation. Chapter 2, Pages 23-28.

ACTIVITIES

TEACHER	STUDENT
1. Have students read topic: Organizational Structures in recommended text.	1. Read topic: Organizational Structures in recommended text.
2. Read topic: Managing a Corporation in the Basic Manufacturing suggested text.	2. Prepare to ask questions concerning why different managers report to different levels of upper management.
3. Discuss with students the various types of structures of local companies.	3. As groups, prepare an organizational chart of the enterprise. This should be your idea of who reports to whom.
4. Form student groups. Have them prepare an organizational chart of what they like as a chain of command or structure. ** This chart should be of the student enterprise.	4. Turn in your rough sketch results to the instructor for evaluation.

EVALUATION CRITERIA: That all students report to and are responsible to some manager and that all managers report to the plant manager or president and the president reports to the board of directors in proper order.

PERFORMANCE OBJECTIVE (Suggested Time: 1 - 2 Days)

* TASK/COMPETENCY:(010). Complete a job application form.

CONDITIONS: Students will be given a blank application form.

STANDARD OF PERFORMANCE: Complete the form with 90 percent accuracy according to the evaluation criteria.

REFERENCES

TEACHER	STUDENT
1. Recommended a. Exploring Manufacturing, Gathering Information. Chapter 22, Pages 178-80. b. APPENDIX "C". Job Application Form. 2. Suggested a. Basic Manufacturing, Job Applications. Chapter 7, Pages 86-89. b. Manufacturing, a basic text, The Job Application. Chapter 10, Pages 138-39.	1. Recommended a. Exploring Manufacturing, Gathering Information. Chapter 22, Pages 178-80. b. APPENDIX "C". Job Application Form.

ACTIVITIES

TEACHER	STUDENT
1. Have students read topic: Gathering Information in recommended text. 2. Duplicate the Appendix "C" Application Form for each student. 3. Have each student complete the application form. Answer questions as they arise. Collect them for your records and the personnel manager's records.	1. Complete the application form as directed. Ask questions for clarification of areas. 2. Turn the completed form to the instructor for evaluation.

EVALUATION CRITERIA: Neatly written, proper blanks filled, correct information, proper references, and contact person.

PERFORMANCE OBJECTIVE (Suggested Time: 1 - 2 Days)

TASK/COMPETENCY: (011). Develop a list of steps required in the hiring process.

CONDITIONS: Students will be given a mock employment vacancy.

STANDARD OF PERFORMANCE: Follow the steps previously listed; select the personnel with 75 percent accuracy according to the qualifications listed on job application.

REFERENCES

TEACHER	STUDENT
1. Recommended a. Exploring Manufacturing, Selecting Employees. Chapter 22, Pages 179-80. 2. Suggested a. Manufacturing, a basic text, Hiring and Training Workers. Chapter 10, Pages 138-141.	1. Recommended a. Exploring Manufacturing, Selecting Employees. Chapter 22, Pages 179-80.

ACTIVITIES

TEACHER	STUDENT
1. Have student become familiar with the hiring process.	1. Be prepared to discuss what you feel are important steps in hiring employees.
2. As a class put together on the blackboard the steps they feel are important for hiring an individual.	2. Be a volunteer for a mock interview as a demonstration.
3. Do a mock interview with a voluntary student as a demonstration.	3. Make application and interview for a position you want in the company.
4. Have managers interview students for positions of which that manager is the supervisor .	4. Take part in the video-taping of some interviews for future use.
5. Videotape some of the interviews for future use.	

PERFORMANCE OBJECTIVE (Suggested Time: 2 - 3 Days)

TASK/COMPETENCY: (012). Develop a system to keep accurate employee records (i.e., class hours; production hours).

CONDITIONS: Students wil be given data of time worked and related times for employees plus computer software.

STANDARD OF PERFORMANCE: Properly store and retrieve this information with 80 percent accuracy.

REFERENCES

TEACHER	STUDENT
1. Recommended a. APPENDIX "D" Procedures & Policies.	1. Recommended a. APPENDIX "D" Procedures & Policies.

ACTIVITIES

TEACHER	STUDENT
1. This activity is designed for the personnel manager.	1. Read the Appendix "D".
2. Have student read the Appendix "D".	2. Organize and arrange a filing system for students' records so that information may be retrieved rapidly.
3. Have the manager and staff organize student records.	
4. Have the manager complete weekly reports which will be handed to the instructor for the records.	3. Complete a weekly report (see the example) for production hours and class hours.

PERSONNEL MANAGER

PERFORMANCE OBJECTIVE (Suggested Time: 1 - 2 Days)

* TASK/COMPETENCY:(013). Define the terminology and functions associated with a personnel manager.

CONDITIONS: Students will be given examples of functions and terminology.

STANDARD OF PERFORMANCE: Complete a performance quiz with 75 percent accuracy.

REFERENCES

TEACHER	STUDENT
1. Recommended a. Exploring Manufacturing, Matching Questions. Chapter 16, Page 141. b. List of Terms and Meanings. 2. Suggested a. Production Technology, Personnel Management. Unit 55.	1. Recommended a. Exploring Manufacturing, Selecting Employees, Organizational Structures, Appendix "B; C; D"

ACTIVITIES

TEACHER	STUDENT
1. Develop a short quiz on terms and functions of personnel management. 2. Have students take the test and achieve 75 percent accuracy.	1. Take a performance test and achieve at least 75 percent.

INTRODUCTION: Let's look at the problem-solving model. The starting point is to identify the problem. Finding out what is already known about the problem may give clues to possible solutions.

PERFORMANCE OBJECTIVE (Suggested Time: 2 - 3 Days)

* TASK/COMPETENCY:(014). Apply the problem-solving model.

CONDITIONS: Students will be given a problematic situation.

STANDARD OF PERFORMANCE: Using the proper steps, solve the situation according to the evaluation criteria.

ENABLING OBJECTIVE: Students must have an understanding of terminology.

REFERENCES

TEACHER	STUDENT
1. Recommended a. Appendix "E". Problem-Solving Model.	1. Recommended a. Appendix "E". Problem-Solving Model.

SELECTED AUDIOVISUAL MATERIALS

Sound Filmstrip entitled, "Developing Products for Manufacturing".

Ball State University.

ACTIVITIES

TEACHER	STUDENT
1. Review the terminology and symbols used in the model.	1. Review the terminology associated with the model.
2. Review the sequence of steps the model takes (may want to simplify model).	2. Become familiar with and know the sequence of steps the model develops to solve problems.
3. Have student form groups (4-5). Give each group a problem situation to solve.	3. As a member of a group; given a problem situation become an active member in the solving of the problem.
4. Rate the final solutions according to the evaluation criteria.	4. Turn the group's final solution in for evaluation.

EVALUATION CRITERIA: Has each step of the model been properly used and correctly labeled according to the problem given? Is the solution part of the alternatives given?

PERFORMANCE OBJECTIVE (Suggested Time: 1 - 2 Days)

TASK/COMPETENCY: (015). Identify the three major kinds of research and development that takes place in industry.

CONDITIONS: Students will be given examples of research and development.

STANDARD OF PERFORMANCE: Place each in the proper category that would be appropriate with 90 percent accuracy.

REFERENCES

TEACHER	STUDENT
1. Recommended a. Basic Manufacturing, Research and Development Chapter 3, Pages 31-32. b. Appendix "F". Types of Research.	1. Recommended a. Appendix "F". Types of Research.

ACTIVITIES

TEACHER	STUDENT
1. Hand out Appendix "F". Types of Research.	1. Read the topic: Types of Research from the handout.
2. Review the terminology associated with research.	2. Review the terminology associated with research.
3. Hand out examples of types of research done in the past and being done presently.	3. Given a handout of examples of products that went through some type of research to be successful.
4. (Homework) Have students place the types of research that took place for the development of the example next to it.	4. Next to each example identify what type of research was used to make the development a possibility.
5. Turn the results in on a due date to the instructor.	5. Turn the answers in for evaluation by the instructor.

PERFORMANCE OBJECTIVE (Suggested Time: 1 - 2 Days)

TASK/COMPETENCY: (016). List at least five sources of product ideas.

CONDITIONS: Students will be given examples of sources.

STANDARD OF PERFORMANCE: Develop a list of at least five products from at least five different sources.

REFERENCES

TEACHER	STUDENT
1. Recommended a. Exploring Manufacturing, Establishing Product Need. Chapter 17, Pages 143-148.	1. Recommended a. Exploring Manufacturing, Establishing Product Needs. Chapter 16, Pages 143-148.
2. Suggested a. Manufacturing, a basic text, Selecting Products. Chapter 6, Pages 80-86. b. Basic Manufacturing, Research & Development. Chapter 3, Pages 31-37.	2. Suggested a. Manufacturing, a basic text, Selecting Products. Chapter 6, Pages 80-86.

ACTIVITIES

TEACHER	STUDENT
1. Have students read the topic: Establishing Product Needs in recommended text. 2. Read topic: Selecting Products in the suggested text. 3. Review the areas to look for ideas such as: - Magazines - Newspapers - Catalogs - Hobby and Craft Stores - Gift Shops 4. Have students generate a list of product ideas for the enterprise, which will be voted upon later.	1. Read topic: Establishing Product Needs in recommended text. 2. Be prepared to discuss some of your ideas for products. Where do ideas come from? 3. Generate a list of at least five products and tell where those ideas came from (At least five different sources). 4. Rough sketch one of five generated. SHOW DIMENSIONS.

PERFORMANCE OBJECTIVE (Suggested Time: 1 - 2 Days)

TASK/COMPETENCY: (017). List and describe the three factors of product design.

CONDITIONS: Students will be shown a list of products.

STANDARD OF PERFORMANCE: Describe what factors had the greatest influence on the product design of 7 out of 10.

REFERENCES

TEACHER	STUDENT
1. Recommended a. Exploring Manufacturing, Design Objectives. Chapter 18, Pages 149-51. 2. Suggested a. Manufacturing, a basic text, Making Design Decisions. Chapter 7, Pages 87-91.	1. Recommended a. Exploring Manufacturing, Design Objectives. Chapter 18, Pages 149-51. 2. Suggested a. Manufacturing, a basic text, Making Design Decisions. Chapter 7, Pages 87-91.

SELECTED AUDIOVISUAL MATERIALS

Sound filmstrip entitled: "Developing Products for Manufacturing".

Ball State University.

ACTIVITIES

TEACHER	STUDENT
1. Have students read the topic: Design Objectives in recommended text.	1. Read the topic: Design Objectives in recommended text.
2. Read the topic: Making Design Decisions in suggested text.	2. Read the topic: Making Design Decisions in suggested text.
3. Have a brief discussion with students about some examples of why products were designed as they are.	3. Be prepared to discuss some examples of different products and the factors to be considered in their design.
4. From the list generated in a previous activity have groups evaluate some of the better ideas based on the factors of design decision making.	4. As groups and from the list of products generated previously, evaluate the products based on the factors of deciding to make that product.
5. Have them write their evaluation and submit to you for credit.	5. Write your evaluation and turn in results to the instructor for credit.

PRODUCT DESIGN

PERFORMANCE OBJECTIVE (Suggested Time: 1 - 2 Days)

* TASK/COMPETENCY: (018). Select the product/products to be prototype.

CONDITIONS: Students will be given a group of product ideas.

STANDARD OF PERFORMANCE: Select the product/products that meet the criteria established.

ENABLING OBJECTIVE: Students must have completed the activity on factors of design decision making.

REFERENCES

TEACHER	STUDENT
1. Recommended a. Exploring Manufacturing, Design Objectives. Chapter 18, Pages 149-51.	1. Recommended a. Exploring Manufacturing, Design Objectives. Chapter 18, Pages 149-51.

ACTIVITIES

TEACHER	STUDENT
1. Put together a list of products that were evaluated. (Hold to 10) 2. Make the list available to students (Handout). 3. Students will vote for the products that will be prototype. 4. The voting procedure suggestions follow: 1. First round - student can vote as many times as he or she wishes for any number of products. 2. Select the top 5 - 6 vote getters. 3. Discuss any of those products. 4. Second round - Student will only vote ONE TIME for ONE PRODUCT. 5. The top 2 - 3 will be prototype.	1. Given a handout of product ideas, you will be given an opportunity to select the product/products to prototype. 2. Discuss the voting procedures for the selection of the product.

PRODUCT DESIGN

PERFORMANCE OBJECTIVE (Suggested Time: 3 - 4 Days)

* TASK/COMPETENCY:(019). Develop a three-dimensional mock-up or prototype of a product.

CONDITIONS: Students be will be given the product idea selected.

STANDARD OF PERFORMANCE: Construct a prototype of a product to be further refined within 75% accuracy of the print or sketch.

ENABLING OBJECTIVE: Students must have a complete understanding of machine operations and school shop safety policies.

REFERENCES

TEACHER	STUDENT
1. Recommended a. Exploring Manufacturing, Preparing Models. Chapter 18, Pages 151-54. 2. Suggested a. Manufacturing, a basic text, Designing Process. Chapter 7, Pages 87-94.	1. Recommended a. Exploring Manufacturing, Preparing Models. Chapter 18, Pages 151-54. 2. Suggested a. Manufacturing, a basic text, Designing Process. Chapter 7, Pages 87-94.

ACTIVITIES

TEACHER	STUDENT
1. Emphasize machine operation safety.	1. Remember proper machine safety and correct operations.
2. Cite the reasons for the prototype: - Test the plans. - Test the product. - See how to produce the product.	2. Read topic: Preparing Models in recommended text. 3. Understand the reason behind the prototype.
3. Place students into workable groups. (one member should know machine operations) (one member should know drafting)	4. As members of groups you must contribute to meet deadlines set by the instructor.
4. Students will have to work outside regular class period.	5. Prototype's will be evaluated for workmanship and ease of manufacturing.

INTRODUCTION: Efficient product development and production is not enough. Goods and services must be effectively marketed at a profit for the enterprise to be successful. Products must be moved from manufacturing to the consumer. This is where marketing becomes a very important phase of any business enterprise. Marketing is the flow of goods or services from the producer to the consumer. To get the marketing job done the following are necessary:

1. Perform market research.
2. Determine the market target.
3. Develop a market plan.
4. Develop product strategy.
5. Develop pricing strategy.
6. Develop advertising strategy.
7. Develop distribution strategy.

PERFORMANCE OBJECTIVE (Suggested Time: 1 - 2 Days)

* TASK/COMPETENCY:(020). List and describe the five major elements of marketing.

CONDITIONS: Students will be given a product/products and a budget.

STANDARD OF PERFORMANCE: Develop a marketing plan that will be completed with 80 percent accuracy according to the evaluation criteria.

REFERENCES

TEACHER	STUDENT
1. Recommended a. Exploring Manufacturing, Developing Marketing Plan. Chapter 27, Pages 215-239.	1. Recommended a. Exploring Manufacturing, Developing Marketing Plan. Chapter 27, Chapter 215-239.

REFERENCES

TEACHER	STUDENT
2. Suggested a. Basic Manufacturing, Marketing. Chapter 9, Pages 109-117. b. Manufacturing a basic text, Marketing: Profit or Loss. Chapter 12, Pages 159-166.	2. Suggested a. Basic Manufacturing, Marketing. Chapter 9, Pages 109-117.

SELECTED AUDIOVISUAL MATERIALS

Sound Filmstrip entitled: "Developing and Presenting a Marketing Plan". Ball State University.

ACTIVITIES

TEACHER	STUDENT
1. Have students read the topic: Marketing in recommended text.	1. Read the topic: Marketing in the recommended text.
2. Read the topic: Marketing in suggested text Basic Manufacturing.	2. Be prepared to discuss in detail why marketing is important to industry. How the basic elements fit into marketing?
3. Discuss with the marketing group in detail the five basic elements of marketing. Why is marketing important to industry?	3. As a group member, given an example product, relate the following elements to the product: 1. Price. 2. Promotion. 3. Distribution. 4. Service.
4. Assign students to groups (4-5 members). Give each student an example product. Have students relate four of the five elements to the product. How would the company: 1. Price. 2. Promote. 3. Distribute. 4. Service. the product?	4. As a group explain how you would accomplish the four elements with the sample product.
	5. Turn in your group's results to the instructor.

EVALUATION CRITERIA: Does the marketing plan use all five of the major elements properly? Are all elements easy to identify in the plan?

PERFORMANCE OBJECTIVE (Suggested Time: 2 - 3 Days)

* TASK/COMPETENCY:(021). Conduct a market research study.

CONDITIONS: Students will be given a sample questionnaire form and the prototype products selected previously.

STANDARD OF PERFORMANCE: The research study will be conducted with 80 percent accuracy according to the evaluation criteria.

REFERENCES

TEACHER	STUDENT
1. Recommended a. Exploring Manufacturing, Consumer Research. Chapter 17, Pages 145-47. b. Basic Manufacturing, Market Survey. Chapter 5 Page 35. c. Appendix "G" Survey Form. 2. Suggested a. Manufacturing, a basic text, Marketing. Chapter 12, Pages 159-161.	1. Recommended a. Exploring Manufacturing, Consumer Research. Chapter 17, Pages 145-47. b. Appendix "G" Survey Form. 2. Suggested a. Basic Manufacturing, Market Survey. Chapter 3, Page 35.

ACTIVITIES

TEACHER	STUDENT
1. Become familiar with the survey form and questions in Appendix "G".	1. Become familiar with the survey form and ask questions about how it is used.
2. Duplicate and distribute the sample survey forms.	2. As members of the prototype product groups you will conduct a survey on your product. You may survey fellow students (outside of class) or adults in the community.
3. Members of the groups will conduct a survey of fellow students (outside of class) or adults in the community concerning the prototype products.	3. The accuracy of the research will determine which product will sell best and make the most profit for the future of the class. (Do an Honest Study)
4. Monitor the groups.	

EVALUATION CRITERIA: Do the returned questionnaires have all questions answered? Is the survey instrument properly filled out with the proper information in the correct places?

PERFORMANCE OBJECTIVE (Suggested Time: 1 - 2 Days)

TASK/COMPETENCY: (022). Complete a marketing Policy and Procedures document.

CONDITIONS: Students will be given a guideline.

STANDARD OF PERFORMANCE: In a written format develop a procedure with 90 percent accuracy according to the format of Appendix "G".

REFERENCES

TEACHER	STUDENT
1. Recommended a. Exploring Manufacturing, Marketing Plan. Chapter 27, Pages 215-19. b. Appendix "G"	1. Recommended a. Exploring Manufacturing, Marketing Plan. Chapter 27, Pages 215-19. b. Appendix "G"

ACTIVITIES

TEACHER	STUDENT
1. Have students read topic: Marketing Plans.	1. Read topic: Marketing Plans in recommended text.
2. Hand out the Appendix "G" to the marketing manager.	2. Give ideas in class on what should be included in the policy and procedures document.
3. Solicit ideas in class on what should be part of the policy or procedures document.	3. Marketing group will complete a document to be circulated among the company and posted on bulletin board.

PERFORMANCE OBJECTIVE (Suggested Time: 1 - 2 Days)

* TASK/COMPETENCY:(023). List and describe the elements of a sales campaign.

CONDITIONS: Students will be given the selected product.

STANDARD OF PERFORMANCE: Using the elements conduct the sales campaign with 90 percent success.

ENABLING OBJECTIVE: In most cases the school board's approval is needed.

REFERENCES

TEACHER	STUDENT
1. Recommended a. Exploring Manufacturing, Selling and Sales. Chapter 29, Pages 228-33. 2. Suggested a. Basic Manufacturing, Selling. Chapter 9, Pages 112-13. b. Manufacturing, a basic text, Sales. Chapter 12, Pages 164-65.	1. Recommended a. Exploring Manufacturing, Selling and Sales. Chapter 29, Pages 228-33.

ACTIVITIES

TEACHER	STUDENT
1. Have students read topic: Selling in recommended text.	1. Read the topic: Selling in recommended text.
2. From the market research analysis select one of the prototypes to mass produce in some quantity.	2. From the market research analysis of the prototypes select one product to be mass produced.
3. Have the marketing group along with the financial group determine the price of the product.	3. With a selected product list the total possible units each member in the group could sell.
4. With a selected product have groups of students list the possible number of units that each group could sell.	4. Conduct the selling of units by the marketing group up to a certain number of unite as determined by production management and instructor.
5. Conduct a selling campaign up to a certain number of units determined by production management and instructor.	5. Follow the guidelines: a. Approach the customer. b. Present the product. c. Close the sale.

PERFORMANCE OBJECTIVE (Suggested Time: 1 - 2 Days)

TASK/COMPETENCY: (024). Describe the functions of advertising.

CONDITIONS: Students will be given the selected product.

STANDARD OF PERFORMANCE: The advertising campaign should be conducted with 80 percent accuracy using the functions of advertising.

REFERENCES

TEACHER	STUDENT
1. Recommended a. Exploring Manufacturing, Promoting Products. Chapter 28, Pages 220-23. 2. Suggested a. Manufacturing, a basic text, Advertising. Chapter 12, Pages 161-64. b. Basic Manufacturing, Advertising. Chapter 9, Page 110.	1. Recommended a. Exploring Manufacturing, Promoting Products. Chapter 28, Pages 220-23.

ACTIVITIES

TEACHER	STUDENT
1. Have students read topic: Promoting Products in recommended text.	1. Read the topic: Promoting Products in recommended text.
2. With the marketing group and with the previously selected product, generate a sales campaign slogan that will be used on all forms of advertising media.	2. As a marketing group you are to generate a written slogan that could/will be used on all forms of advertising media.
	3. Turn in the results to the instructor for evaluation.

PERFORMANCE OBJECTIVE (Suggested Time: 1 - 2 Days)

* TASK/COMPETENCY:(025). List and describe the five major functions of a package.

CONDITIONS: Students will be given sample packages.

STANDARD OF PERFORMANCE: List the function that each package serves with 70 percent accuracy.

REFERENCES

TEACHER	STUDENT
1. Recommended a. Exploring Manufacturing, Packaging. Chapter 28, Pages 224-27. 2. Suggested a. How Do They Package It? Westminister Press. b. Basic Manufacturing, Packaging. Chapter 9, Pages 111-12.	1. Recommended a. Exploring Manufacturing, Packaging. Chapter 28, Pages 224-27.

SELECTED AUDIOVISUAL MATERIALS

Filmstrip Entitled: "Designing and Producing Packages".

Ball State University.

ACTIVITIES

TEACHER	STUDENT
1. Have students read topic: Packaging in recommended text.	1. Read the topic: Packaging in recommended text.
2. Discuss the uses of packages and show examples such as: liter bottles, blister packs, cereal box.	2. Be prepared to discuss examples of packages and their function.
3. Have students select five packaged products. Analyze the package to determine how well it protects, promotes, and provides information.	3. As individuals, select five packaged products. Analyze each one to determine if it protects, promotes and provides information about the product.
4. Evaluate the answers according to the five major functions.	4. As a group, select the type of package that will be used for the company product.

PERFORMANCE OBJECTIVE (Suggested Time: 1 - 2 Days)

TASK/COMPETENCY: (026). List and describe the methods for distributing a product.

CONDITIONS: Students will be given the previously selected product.

STANDARD OF PERFORMANCE: Determine the best method to distribute a product by the most economical means.

REFERENCES

TEACHER	STUDENT
1. Recommended a. Exploring Manufacturing, Channels of Distribution. Chapter 29, Pages 228-29. 2. Suggested a. Manufacturing, a basic text, Distribution. Chapter 12, Page 165. b. Basic Manufacturing, Distribution. Chapter 9, Pages 113-14.	1. Recommended a. Exploring Manufacturing, Channels of Distribution. Chapter 29, Pages 228-29.

ACTIVITIES

TEACHER	STUDENT
1. Have students read the topic: Channels of Distribution in recommended text.	1. Read the topic: Channels of Distribution in recommended text.
2. Discuss the different products sold by various means of distribution.	2. Develop a list of products (5 or more) which are sold through the various methods of distribution.
3. Have marketing group select a distribution channel for the product selected. This method should be the best for the company and customer in terms of economics.	3. Marketing group will select a distribution channel for the selected product which should be the most economical for the company.
4. Have each student develop a list of 5 or more products which are distributed through the various channels.	

INTRODUCTION: Money is an important resource to any enterprise. It takes money to start, operate, and continue any business enterprise. The financial manager's position is responsible for the task of coordinating, planning, and controlling the money of the enterprise. The basic functions of finance are (1) finding adequate operating funds and (2) wisely using those funds. The following financial elements and questions are important:

1) Need - for what does the company need money?
2) Quantity - how much money is needed?
3) Source - where does the money come from?
4) Control - how will the finances be regulated?
5) Money Cost - how much will it cost to get the money needed?

These are important questions to be answered in this next section of activities.

PERFORMANCE OBJECTIVE (Suggested Time: 1 - 2 Days)

TASK/COMPETENCY: (027). Describe types of company ownerships in industry.

CONDITIONS: Students will be given examples of ownership.

STANDARD OF PERFORMANCE: In a brief written form describe which ownership is better for each example with 80 percent accuracy.

REFERENCES

TEACHER	STUDENT
1. Recommended a. Exploring Manufacturing, Organizing an Enterprise. Chapter 16, Pages 133-37.	1. Recommended a. Exploring Manufacturing, Organizing an Enterprise. Chapter 16, Pages 133-37.

REFERENCES

TEACHER	STUDENT
2. Suggested a. Basic Manufacturing, Ownership. Chapter 2, Pages 21-30. b. Manufacturing, a basic text, Types of Ownership. Chapter 8, Pages 104-116.	2. Suggested a. Basic Manufacturing, Ownership. Chapter 2, Pages 21-30.

ACTIVITIES

TEACHER	STUDENT
1. Have students read the topic: Ownerships in recommended text. 2. Using examples from the community and from other sources. Have the students write a brief statement why the present ownership of the company is the best (if it is). 3. Evaluate their answers based on advantages of each type of ownership.	1. Read topic: Ownerships in recommended text. 2. Given example companies, write a brief statement which ownership type is appropriate for that type of company. (Remember the advantages and disadvantages of each type).

PERFORMANCE OBJECTIVE (Suggested Time: 1 - 2 Days)

* TASK/COMPETENCY:(028). Select your student enterprise ownership type.

CONDITIONS: Students will be given the four types of ownership.

STANDARD OF PERFORMANCE: Select one of the four types of ownership that best meets the needs of the class.

REFERENCES

TEACHER	STUDENT
1. Recommended	1. Recommended
a. Exploring Manufacturing, Organizing an Enterprise. Chapter 16, Pages 133-37.	a. Exploring Manufacturing, Organizing an Enterprise. Chapter 16, Pages 133-37.
2. Suggested	2. Suggested
a. Basic Manufacturing, Ownerships. Chapter 2, Pages 21-30.	a. Manufacturing, a basic text, Types of Ownership. Chapter 8, Pages 104-116.
b. Manufacturing, a basic text, Types of Ownership. Chapter 8, Pages 104-116.	

ACTIVITIES

TEACHER	STUDENT
1. Have students read the topic: Ownership in recommended text.	1. Read the topic: Ownership in recommended text.
2. Using samples from text-books and elsewhere, guide the class members in making the decisions needed to develop a Certificate of Incorporation for the enterprise.	2. As a group do the following: A) Select a company name. B) design a trademark.
3. If time permits, prepare the bylaws.	3. Using samples from the textbooks and elsewhere develop a Certificate of Incorporation for the class enterprise.
4. Design and produce stock certificates.	4. Design and produce stock certificates.
	5. Turn in the results to the president and instructor for publication.

PERFORMANCE OBJECTIVE (Suggested Time: 1 - 2 Days)

TASK/COMPETENCY: (029). Develop sources of financing and "cash flow" for the company.

CONDITIONS: Students will be given examples and blank forms.

STANDARD OF PERFORMANCE: Successfully generate enough capital to start the company according to the evaluation criteria.

REFERENCES

TEACHER	STUDENT
1. Recommended a. Exploring Manufacturing, Financing. Chapter 16, Pages 139-41. Chapter 31, Pages 241-46. b. Appendix "H" Financing. 2. Suggested a. Basic Manufacturing, Financial Control. Chapter 10, Page 119-122.	1. Recommended a. Exploring Manufacturing, Financing. Chapter 16, Pages 139-41. Chapter 31, Pages 241-46. b. Appendix "H" Financing.

ACTIVITIES

TEACHER	STUDENT
1. Have students read topic: Financing in recommended text.	1. Read the topic: Financing in recommended text.
2. Duplicate and dispense Appendix "H".	2. Read the Appendix Handout.
3. Have students as groups generate a list of sources of capital. A master list will be developed using ideas from all groups.	3. As part of your group, you must generate a list of sources of capital. Turn this list into the instructor for compiling.
4. Have students as groups determine the budgets relating to cost of starting production. 1) Material needs. 2) Labor. 3) Overhead. 4) Advertising (Marketing) 5) Administrative.	4. As part of your group you also must determine the cost budgets for the following areas: 1) Material needs. 2) Labor. 3) Overhead. 4) Advertising (Marketing) 5) Administrative.
5. Guide the students through the selling of stocks to begin the company.	5. As a class, we must generate start-up money through some source of financing.

EVALUATION CRITERIA: Can the group pay for the raw material and tooling to make a run of products?

PERFORMANCE OBJECTIVE (Suggested Time: 1 - 2 Days)

* TASK/COMPETENCY:(030). Define the types of cost associated with operating a company.

CONDITIONS: Students will be given examples of typical cost of operating a company.

STANDARD OF PERFORMANCE: Properly identify and classify these costs with 80 percent accuracy.

REFERENCES

TEACHER	STUDENT
1. Recommended a. Appendix "H" Finance Manager. 2. Suggested a. Basic Manufacturing, Financial Control. Chapter 10, Pages 122-23.	1. Recommended a. Appendix "H" Finance Manager.

ACTIVITIES

TEACHER	STUDENT
1. Give students examples of the three types of cost: a) Direct b) Indirect c) Production d) Fixed cost e) Variable f) Overhead g) Administrative.	1. Ask questions concerning classifying of cost associated with manufacturing.
2. Hand out a sample of cost associated with manufacturing.	2. Classify each example into the proper cost category after discussing the various types of cost.
3. Have students classify which type of cost each example is associated with.	3. Return the sheet with answers to instructor for evaluation.
4. Collect student answers after a set time limit and evaluate accordingly.	

PERFORMANCE OBJECTIVE (Suggested Time: 1 - 2 Days)

TASK/COMPETENCY: (031). Define the terminology associated with break-even analysis.

CONDITIONS: Students will be given a list of terms or meanings.

STANDARD OF PERFORMANCE: Match the proper combination with 80 percent accuracy.

REFERENCES

TEACHER	STUDENT
1. Recommended a. Appendix "H" Finance Manager; Break-even Analysis. 2. Suggested a. Basic Manufacturing, Financial Control. Chapter 10, Pages 119-125.	1. Recommended a. Appendix "H" Finance Manager; Break-even Analysis. 2. Suggested a. Basic Manufacturing, Financial Control. Chapter 10, Pages 119-125.

ACTIVITIES

TEACHER	STUDENT
1. Have students read topic: Break-even in Appendix "H".	1. Read topic: Break-even in Appendix "H".
2. Have students draw basic break-even graphs with sample data.	2. Be prepared to answer questions during a demonstration of formulas and graphs.
3. Discuss terminology and basic points and functions of the break-even graph.	3. Be able to draw basic graphs of break-even.
4. Give a demonstration using the formula for break-even and graph the solution.	4. Take a performance test on terminology and formulas of break-even.
5. Hand out a performance test on break-even information.	
6. Evaluate the test.	

PERFORMANCE OBJECTIVE (Suggested Time: 2 - 3 Days)

* TASK/COMPETENCY: (032). Complete a break-even graph and analysis for the company.

CONDITIONS: Students will be given your company's data and computer software.

STANDARD OF PERFORMANCE: Complete a break-even analysis with 80 percent accuracy according to the evaluation criteria.

ENABLING OBJECTIVE: Students must have an understanding of the terminology of an Apple computer and how to input and retrieve data.

REFERENCES

TEACHER	STUDENT
1. Recommended a. Appendix "H" Finance Manager. 2. Suggested a. Basic Manufacturing, Financial Control. Chapter 10, Pages 119-125.	1. Recommended a. Appendix "H" Finance Manager.

ACTIVITIES

TEACHER	STUDENT
1. Input the software program onto a diskette for students.	1. Observe a demonstration of a software package on break-even analysis.
2. Demonstrate the software package for the students.	2. Load (Input) data from forecast and budgets into the computer and process the information, getting a printout.
3. Guide the students of the financial group through the use of the package.	3. Analyze the printout and in writing relate as much information about break-even as you can to the instructor.
4. Discuss the results of the printout. Explain the point when the company will become profitable.	

EVALUATION CRITERIA: Is the graph correctly labeled? Are the lines of the graph correct? Is the formula properly applied with the correct numbers used?

PERFORMANCE OBJECTIVE (Suggested Time: 1 - 2 Days)

TASK/COMPETENCY: (033). Define the terminology and describe the basic format associated with general financial statements.

CONDITIONS: Students will be given some blank forms and sample data/or real data from the company.

STANDARD OF PERFORMANCE: Complete a set of financial statements with 80 percent accuracy.

REFERENCES

TEACHER	STUDENT
1. Recommended a. Exploring Manufacturing, Financial Records. Chapter 31, Pages 241-46. 2. Suggested a. Basic Manufacturing, Financial Reports. Chapter 10, Pages 123-27.	1. Recommended a. Exploring Manufacturing, Financial Records. Chapter 31, Pages 241-46. 2. Suggested a. Basic Manufacturing, Financial Reports. Chapter 10, Pages 123-27.

ACTIVITIES

TEACHER	STUDENT
1. Have students read topic: Financial Records in recommended text.	1. Read the topic: Financial Records in recommended text.
2. Discuss the terminology and format associated with income statements and balance sheets with the financial manager's group.	2. Be prepared to ask questions about terminology and format of income statements and balance sheets.
3. The financial manager should be able to generate the numbers for the following areas: 1) Income. 2) Expenses. 3) Tooling Cost. 4) Cash on Hand. 5) Accounts Receivable. 6) Accounts Payable.	3. Prepare a balance sheet and income statement for the company. 4. The key is to be accurate and cooperate with each group.
4. Guide the financial group with the first of three financial statements required.	

INTRODUCTION: The plant engineer is a part of the production team, and is directly responsible to the production manager. The main responsibilities of the plant engineer are:

1. Operation process charts.
2. Plant layout.
3. Plant services.
4. Safety.
5. Material handling.
6. Plant maintenance.

What they offer to the production system is a service function. One of these functions is the aspect of safety, which is critical.

PERFORMANCE OBJECTIVE (Suggested Time: 1 - 2 Days)

* TASK/COMPETENCY:(034). Complete a safety awareness program.

CONDITIONS: Students will be given school policy, poster stock, and graphic art supplies.

STANDARD OF PERFORMANCE: The awareness program should be completed with 90 percent accuracy according to school's policy and teacher's policy on safety and students must pass a safety test with 100 percent accuracy.

REFERENCES

TEACHER	STUDENT
1. Recommended a. Exploring Manufacturing, Maintaining Safety. Chapter 25, Page 203. 2. Suggested a. Appendix "I" Safety.	1. Recommended a. Exploring Manufacturing, Maintaining Safety. Chapter 25, Page 203. b. School policy on laboratory safety. 2. Suggested a. Appendix "I". Safety.

REFERENCE

TEACHER	STUDENT
2. Suggested b. Manufacturing, a basic text, Workers and Safety. Pages 52-59.	2. Suggested b. Manufacturing, a basic text, Workers and Safety. Pages 52-59.

SELECTED AUDIOVISUAL MATERIALS

Color sound filmstrip "Machine Tool Safety".

ACTIVITIES

TEACHER	STUDENT
1. Hand out Appendix "I" and your school policy on safety. 2. Discuss the handout and highlight important areas of frequent violations in past classes. 3. Emphasize the consequences from violations of the rules. 4. Guide student groups (4-5) to participate in a safety poster contest. (You establish the rules for the contest.)	1. Be prepared to answer questions concerning the handout on Safety. 2. Participate as part of a group in a Safety Poster Contest. 3. Complete a safety test with 100 percent accuracy.

PERFORMANCE OBJECTIVE (Suggested Time: 1 - 2 Days)

TASK/COMPETENCY:(035). List and describe four types of Plant Layout.

CONDITIONS: Students will be given examples of industry.

STANDARD OF PERFORMANCE: Classify each industry example by the type of layout or combination of layouts with 80 percent accuracy.

REFERENCES

TEACHER	STUDENT
1. Recommended a. Exploring Manufacturing, Preparing Plant Layout Chapter 21, Pages 173-74. b. Appendix "J" Plant Layout.	1. Recommended a. Exploring Manufacturing, Preparing Plant Layout. Chapter 21, Pages 173-74.
2. Suggested a. Manufacturing, a basic text, Plant Layout. Chapter 9, Page 126.	2. Suggested a. Appendix "J" Plant Layout.

ACTIVITIES

TEACHER	STUDENT
1. Have the students read the topic: Plant Layout in recommended text.	1. Read the topic on Plant Layout in recommended text.
2. Give examples of the four different types of layout.	2. Be prepared to discuss the examples of plant layout types.
3. Hand out a sheet of samples of industrial layouts. Students are to identify which type or combination of types each sample is.	3. Identify the layout type or combination of types for each example given on a handout by the instructor.
4. Have students return the answers to be evaluated.	4. Turn your results in for evaluation.

PERFORMANCE OBJECTIVE (Suggested Time: 1 - 2 Days)

TASK/COMPETENCY: (036). Identify and list methods of moving parts and products around the plant.

CONDITIONS: Students will be given an example of an existing plant layout.

STANDARD OF PERFORMANCE: Develop improvements in sketch or drawing form with 70 percent accuracy of the methods identified in class being used.

ENABLING OBJECTIVE: Students must have an understanding of plant layout types.

REFERENCES

TEACHER	STUDENT
1. Recommended a. Exploring Manufacturing, Designing Material Handling. Chapter 21, Pages 174-176. 2. Suggested a. Manufacturing, a basic text, Planning a Material Handling System. Chapter 9, Pages 127-129.	1. Recommended a. Exploring Manufacturing, Designing Material Handling. Chapter 21, Pages 174-176.

ACTIVITIES

TEACHER	STUDENT
1. Have students read the topic: Material Handling in recommended text.	1. Read the topic: Material Handling in recommended text.
2. Show a movie on material handling if available.	2. As a group, design an improved plant layout for the student's company.
3. Give examples of different devices of fixed and variable path units.	3. Turn in results to the instructor for evaluation.
4. Guide the students (especially the plant engineering group) in the design of a plant layout for the student's company.	

INTRODUCTION: The materials manager is directly responsible to the president of your student enterprise. The materials manager, today, is more than a purchasing agent. It involves the responsibility of purchasing, inventory control, storage, and material handling. These responsibilities take place before the materials or parts are released into the production system. Materials requirements planning has become a critical part of this system.

PERFORMANCE OBJECTIVE (Suggested Time: 2 - 3 Days)

TASK/COMPETENCY: (037). Utilize a Materials Requirements Planning concept.

CONDITIONS: Students will be given a Bill of Material sample from a product.

STANDARD OF PERFORMANCE: Determine the inventory requirements with 70 percent accuracy.

REFERENCES

TEACHER	STUDENT
1. Recommended a. Basic Manufacturing, Bill of Material. Chapter 5, Pages 57-58. b. Manufacturing, a basic text, Managing Material. Chapter 10, Pages 130-31. 2. Suggested a. Production and Inventory Control in the Computer Age.	1. Recommended a. Basic Manufacturing, Bill of Material. Chapter 5, Pages 57-58.

ACTIVITIES

TEACHER	STUDENT
1. Have students read the topic: Material Control, MRP, JIT in Appendix "K".	1. Read the topic: Material Control, MRP, JIT in Appendix "K".
2. With help of the manufacturing manager, develop a simple Multi-level Bill of Material.	2. As a group, you will be given a product part to use in determining the inventory requirements to order that will complete a forecasted production run.
3. Demonstrate the use of the Bill of Material and how to determine inventory requirements.	3. Turn in the results to the materials manager and instructor.
4. Guide each group with determining requirements for a product part.	
5. Have students turn in the results to the materials manager and instructor.	

PERFORMANCE OBJECTIVE (Suggested Time: 1 - 2 Days)

TASK/COMPETENCY: (038). Develop a list of sources or suppliers of raw material and component parts for the company product.

CONDITIONS: Students will be given materials requirements of the company product.

STANDARD OF PERFORMANCE: Determine the most economical source/suppliers to obtain the materials requirements for the product.

REFERENCES

TEACHER	STUDENT
1. Recommended a. Exploring Manufacturing, Bids and Quotes. Chapter 22, Page 182.	1. Recommended a. Exploring Manufacturing, Bids and Quotes. Chapter 22, Page 182.

ACTIVITIES

TEACHER	STUDENT
1. Have students read topic: Bids and Quotes in recommended text.	1. Read the topic: Bids and Quotes in recommended text.
2. Guide the students in developing a list of potential vendors of raw material and parts.	2. Given a list of materials needed, select a supplier which will give prompt delivery, good quality, and be economical.
3. Help students find the current prices of materials (lumber, screws, etc.).	3. Turn in list to the materials manager and instructor.
4. Help by furnishing a list of suppliers the school works with in the local area.	
5. Guide the materials manager through compiling a master vendor list that will be used.	

PERFORMANCE OBJECTIVE (Suggested Time: 2 - 3 Days)

* TASK/COMPETENCY: (039). Complete a purchase requisition form for raw material or parts.

CONDITIONS: Students will be given a sample form and the materials needed.

STANDARD OF PERFORMANCE: Complete the form with 100 percent accuracy.

REFERENCES

TEACHER	STUDENT
1. Recommended a. Exploring Manufacturing, Purchasing Materials. Chapter 22, Pages 181-84.	1. Recommended a. Exploring Manufacturing, Purchasing Materials. Chapter 22, Pages 181-84.

ACTIVITIES

TEACHER	STUDENT
1. Have students read topic: Purchasing Materials in recommended text.	1. Read the topic: Purchasing Materials in recommended text.
2. Give each student group the material list and suppliers chosen in a previous activity.	2. Given a material needed list and vendor list fill out the purchase requisition form to acquire the materials.
3. Have each group fill out the blank purchase requisition for material needed found in Appendix.	3. The forms will be collected and verified for accuracy.
4. Collect the completed forms and evaluate to verify correct information.	

PERFORMANCE OBJECTIVE (Suggested Time: 2 - 3 Days)

TASK/COMPETENCY: (040). Complete the Purchase Order that would be used to order parts.

CONDITIONS: Students will be given the purchase requisition and blank purchase order form.

STANDARD OF PERFORMANCE: Complete a purchase order form with 100 percent accuracy.

REFERENCES

TEACHER	STUDENT
1. Recommended a. Exploring Manufacturing, Purchase Orders. Chapter 22, Page 182.	1. Recommended a. Exploring Manufacturing, Purchase Orders. Chapter 22, Page 182.

ACTIVITIES

TEACHER	STUDENT
1. Have the students read the topic: Purchase Orders in recommended text.	1. Read the topic: Purchase Orders in recommended text.
2. Give students blank purchase order forms and purchase requisitions from a previous activity.	2. Given blank purchase order forms follow along with the instructor in the demonstration in the proper manner to complete the form.
3. Demonstrate the proper manner to complete the purchase order.	3. Given a purchase requisition take this information and properly complete the purchase order.
4. Have students complete the form with your guidance.	4. These forms will be collected for verification of information and filed for payment approval at a later date.
5. Collect all purchase orders to be verified and properly filed for payment at a later date.	

PERFORMANCE OBJECTIVE (Suggested Time: 1 - 2 Days)

TASK/COMPETENCY: (041). Complete a typical purchasing procedures document for the company.

CONDITIONS: Students will be given a sample format and guideline.

STANDARD OF PERFORMANCE: In written form develop a procedure to follow with 80 percent accuracy according to the sample format.

REFERENCES

TEACHER	STUDENT
1. Recommended a. Exploring Manufacturing, Purchasing Materials. Chapter 22, Pages 181-84. b. Appendix "L" Procedures Guideline.	1. Recommended a. Exploring Manufacturing, Purchasing Materials. Chapter 22, Pages 181-84. b. Appendix "L" Procedures Guideline.

ACTIVITIES

TEACHER	STUDENT
1. Review the contents of Purchasing Materials.	1. Participate in the review session on procedures to follow for obtaining materials or supplies.
2. Hand out copies of Appendix "L".	
3. Have the materials manager's group draw up a set of procedures to follow for the company.	2. Give suggestions in the development of these procedures to make this aspect of the enterprise run smoothly.
4. Distribute the copies of these procedures to the class and post a copy on the bulletin board.	3. Turn in all suggestions to the instructor and materials manager for finalization.

INTRODUCTION: The manufacturing engineers are a part of the production team, and are directly responsible to the production manager. The manufacturing engineers have two primary responsibilities. They are:

1. Develop operation process charts.
2. Develop tooling, jigs, and fixtures for production.

The manufacturing engineers must be knowledgeable of many production processes and the availability of equipment in the shop, not just the operation of machines but what machines will be able to perform what operations. This is important for deciding what machines to use for the various production operations. The development of tooling, jigs, and fixtures becomes critical to providing quality parts as well as standardized parts.

PERFORMANCE OBJECTIVE (Suggested Time: 1 - 2 Days)

* TASK/COMPETENCY: (042). List the three major considerations when designing tooling.

CONDITIONS: Students will be given examples of tooling.

STANDARD OF PERFORMANCE: Cite the considerations that were utilized with 70 percent accuracy according to the considerations of designing tooling.

REFERENCES

TEACHER	STUDENT
1. Recommended a. Exploring Manufacturing, Designing Tooling. Chapter 21, Pages 172-73.	1. Recommended a. Exploring Manufacturing, Designing Tooling. Chapter 21, Pages 172-73.

REFERENCES

TEACHER	STUDENT
2. Suggested	2. Suggested
a. Basic Manufacturing, Tooling up. Chapter 4, Pages 43-48.	a. Basic Manufacturing, Tooling up. Chapter 4, Pages 43-48.
b. Manufacturing, a basic text, Production Tooling. Topic 25, Pages 402-409.	b. Manufacturing, a basic text, Production Tooling. Topic 25, Pages 402-409.

ACTIVITIES

TEACHER	STUDENT
1. Have students read the topic: Designing Tooling in recommended text	1. Read the topic: Designing Tooling in recommended text.
2. You may want to copy the Production Tooling topic in the suggested text.	2. Read the topic: Production Tooling in the suggested text; Manufacturing, a basic text.
3. Make arrangements to tour a fabrication plant or any type of industry to survey various types of tooling used.	3. Given examples of tooling, write the general considerations that were given for the design and use of the jig or fixture.
4. Using tooling from past projects or borrowed fixtures from industry have the students determine what considerations went into the design and use of the jig or fixture.	

PERFORMANCE OBJECTIVE (Suggested Time: 1 - 2 Days)

* TASK/COMPETENCY:(043). Define the terminology associated with tooling, jigs, and fixtures.

CONDITIONS: Students will be given a list of terms or meanings.

STANDARD OF PERFORMANCE: Define each term with 80 percent accuracy.

REFERENCES

TEACHERS	STUDENTS
1. Recommended a. Manufacturing, a basic text, Production Tooling. Topic 25, Pages 402-409. b. List of Terms.	1. Recommended a. Manufacturing, a basic text, Production Tooling. Topic 25, Pages 402-409.

ACTIVITIES

TEACHER	STUDENT
1. Have the students read the topic: Production Tooling in recommended text. 2. Discuss the terms associated with tooling. 3. Hand out a performance quiz on the terms and ideas associated with production tooling.	1. Read the topic and terms associated with production tooling in recommended text. 2. Take a performance quiz on the unit dealing with production tooling. 3. Turn in the test to instructor for evaluation.

PERFORMANCE OBJECTIVE (Suggested Time: 2 - 3 Days)

TASK/COMPETENCY: (044). Make a list of all machine processes available in the school shop.

CONDITIONS: Students will be given a list of machines available.

STANDARD OF PERFORMANCE: Complete the list of processes of 70 percent of the machines listed.

ENABLING OBJECTIVE: Students will have some basic knowledge of general shop processes and machines required for each process.

REFERENCES

TEACHER	STUDENT
1. Recommended a. Exploring Manufacturing, Processes. Chapter 8-14, Pages 69-125.	1. Recommended a. Exploring Manufacturing, Processes. Chapter 8-14, Pages 69-125.
2. Suggested a. Manufacturing, a basic text, Processes. Topics 2-23, Pages 300-399.	2. Suggested a. Manufacturing, a basic text, Processes. Topics 2-23, Pages 300-399.

ACTIVITIES

TEACHER	STUDENT
1. Review some machine processes that you feel are essential for making this particular product.	1. As a group, make a list of laboratories you may need to carry out your responsibilities to the company, (i.e., what will marketing need to make advertisement posters, packaging?).
2. Have students of each group make a list of laboratories that may be used with instructor permission.	2. As a group, you will also list the processes that may be needed to perform your job.
3. Have students of each group make a list of processes that may be performed on which machines in which laboratories.	3. You are to obtain permission to use machines in other laboratories from the proper authority. Also, obtain the times each laboratory is available for use.
4. Have students obtain written consent for use of other laboratories and obtain the times the laboratories are available for use.	
5. Turn in the list to the manufacturing engineer and instructor.	4. Turn in your list to the manufacturing engineer and instructor.

PERFORMANCE OBJECTIVE (Suggested Time: 2 - 3 Days)

* TASK/COMPETENCY:(045). Use a jig and fixture design sheet.

CONDITIONS: Students will be given a sample of a design sheet, and product operation calling for a fixture or jig.

STANDARD OF PERFORMANCE: Develop a jig or fixture that will permit the production of consistently accurate parts or assembly operations.

ENABLING OBJECTIVE: Students must have an understanding of the functions of tooling and the considerations given to the development of such tooling.

REFERENCES

TEACHER	STUDENT
1. Recommended a. Exploring Manufacturing, Designing Tooling. Chapter 21, Pages 172-73. b. Appendix "M" Design Sheet Sample. 2. Suggested a. Manufacturing, a basic text, Production Tooling. Topic 25, Pages 402-409.	1. Recommended a. Exploring Manufacturing, Designing Tooling. Chapter 21, Pages 172-73. b. Appendix "M" Design Sheet Sample.

SELECTED AUDIOVISUAL MATERIALS

Sound Filmstrip entitled "Introduction to Tooling Design"
Ball State University.

ACTIVITIES

TEACHER	STUDENT
1. Hand out copies of Appendix "M" Design Sheet sample. 2. Guide the manufacturing manager's group and production group through the design of a jig or fixture for the product. 3. Observe the input from different students. Work on more than one design at a time.	1. As part of the manufacturing group and production group, design a jig or fixture that will be used in the production of the company's product. 2. Smaller subgroups will save time by working on more than one design at a time. 3. Turn all designs in for approval.

INTRODUCTION: Establishing a quality control program for an enterprise is as critical as producing the product. Most companies in the competitive marketplace must strive to supply reliable and quality products at competitive prices. Few companies can stand the test of time when their major product lines substitute a goal of profit at the expense of designing quality products, obtaining quality materials, and using quality processes performed through quality workmanship. Using this approach, quality is designed and manufactured into consumer products within the limitations of reasonable cost. Quality control entails a much broader outlook than inspection. Inspection is geared to accept or reject according to specified standards. Quality control is directed toward future production rather than past production. Quality control is sometimes referred to as quality assurance because it must assure the quality is designed into the product and assure that standards are being adhered to in production. A complete quality control program consists of three phases. They are:

1. Quality Assurance.
2. Worker Attitude.
3. Inspection.

PERFORMANCE OBJECTIVE (Suggested Time: 1 - 2 Days)

* TASK/COMPETENCY: (046). Define the terminology associated with Quality Control.

CONDITIONS: Students will be given a list of terms or meanings.

STANDARD OF PERFORMANCE: Define each term with 70 percent accuracy.

REFERENCES

TEACHER	STUDENT
1. Recommended a. Exploring Manufacturing, Controlling Quality. Chapter 23, Pages 190-92 Chapter 24, Pages 198-201 2. Suggested a. Basic Manufacturing, Quality Control. Chapter 6, Pages 75-83. b. Manufacturing, a basic text, Inspecting. Chapter 11, Page 148.	1. Recommended a. Exploring Manufacturing, Controlling Quality. Chapter 23, Pages 190-92 Chapter 24, Pages 198-201 2. Suggested a. Basic Manufacturing, Quality Control. Chapter 6, Pages 75-83.

ACTIVITIES

TEACHER	STUDENT
1. Have students read topic: Quality Control in recommended text. 2. Discuss the primary job of quality control managers along with the terminology associated with their job. 3. Hand out performance quiz which deals with quality control. 4. Evaluate the results of the performance quiz.	1. Read the topic: Quality Control in recommended text. 2. Read the list of terminology in the suggested text. 3. Take a performance quiz which deals with quality control. 4. Return the answers to the instructor.

PERFORMANCE OBJECTIVE (Suggested Time: 3 - 4 Days)

* TASK/COMPETENCY:(047). Identify the distinct steps in a quality control program.

CONDITIONS: Students will be given a sample program and production system.

STANDARD OF PERFORMANCE: Develop a program for your company's product using 70 percent of the steps required of a quality control program.

ENABLING OBJECTIVE: Students must have an understanding of terminology, product specifications, and tolerances.

REFERENCES

TEACHERS	STUDENT
1. Recommended a. Basic Manufacturing, Inspection Procedures and Records. Chapter 6, Pages 79-81. b. Appendix "N" Quality Control. 2. Suggested a. Quality Control, A Practical Approach.	1. Recommended a. Appendix "N" Quality Control.

SELECTED AUDIOVISUAL MATERIAL

Sound filmstrip entitled: "Quality Control"
Ball State University.

ACTIVITIES

TEACHER	STUDENT
1. Hand out copies of Appendix "N" Quality Control.	1. Read the copy of Appendix "N" Quality Control.
2. Have the quality control group work on the procedures and records for inspection of the product along with the production group.	2. Work with the production control group and manufacturing engineering on the procedures and records needed to inspect the product, parts, and materials.
3. Be a guide as to when and how to inspect the parts.	3. Turn in a copy of the procedures to the company president and production control, and post copy on the bulletin board.
4. Post the inspection procedures on the bulletin board and send copy to the company president and production control manager.	

PERFORMANCE OBJECTIVE (Suggested Time: 1 - 2 Days)

* TASK/COMPETENCY:(048). Develop a quality control work order for an inspection station for the enterprise.

CONDITIONS: Student will use a flow process chart from production group, sample blank forms, and a product prototype.

STANDARD OF PERFORMANCE: Complete the work order in detail with 80 percent accuracy according to the sample blank form.

ENABLING OBJECTIVE: Student must have an understanding of the symbols of a flow process chart.

REFERENCES

TEACHER	STUDENT
1. Recommended a. Appendix "N" Sample Work Order.	1. Recommended a. Appendix "N" Sample Work Order.

ACTIVITIES

TEACHER	STUDENT
1. Discuss the use of the inspection work order with the group.	1. Be prepared to discuss the use of inspection work orders.
2. Work as a guide with the quality control group and have them develop the work orders for inspection points.	2. Develop work orders for inspection points in the production process: - Receiving of materials, parts. - In-Process inspections. - Finished products.
3. Have the group turn in a sample for evaluation.	3. Turn in samples of the work orders to the instructor for evaluation.

PERFORMANCE OBJECTIVE (Suggested Time: 1 - 2 Days)

* TASK/COMPETENCY:(049). Perform the inspections required to meet customer demands and make a quality product.

CONDITIONS: Student will be given a product, operations flow chart, sample inspection tags and tickets, and inspection work orders.

STANDARD OF PERFORMANCE: Complete the inspection process as required with 90 percent accuracy according to the requirements of the inspection work order.

ENABLING OBJECTIVE: Student must have an understanding of the terms, inspection work order, what constitutes rework or reject criteria, the ability to read gauges and instruments needed for inspection.

REFERENCES

TEACHER	STUDENT
1. Recommended a. Exploring Manufacturing, Controlling Quality. Chapter 23, Pages 190-192. Chapter 24, Pages 198-201. b. Basic Manufacturing, Quality Control. Chapter 6, Pages 75-83. c. Appendix "N" Quality Control. Sample Work Orders. 2. Suggested a. Manufacturing, a basic text, Inspecting. Chapter 11, Page 148.	1. Recommended a. Exploring Manufacturing, Controlling Quality. Chapter 23, Pages 190-192. Chapter 24, Pages 198-201. b. Appendix "N" Quality Control. Sample Work Orders. 2. Suggested a. Basic Manufacturing Quality Control. Chapter 6, Pages 75-83.

ACTIVITIES

TEACHER	STUDENT
1. Act as a guide for the quality control group and machine operators through an inspection process. 2. Have the students perform inspections as required on the flow process charts and according to the inspection work orders or production work orders.	1. As individual machine operators and inspectors you are required to perform inspections according to the flow process charts and inspection work orders and production work orders. 2. Results will be collected by the quality control manager and the instructor will monitor the process for evaluation purposes.

PRODUCTION CONTROL

INTRODUCTION: Production planning and control (PPC) is an extremely important function which must be done before production can begin and carries throughout the production phase. Without adequate planning and control, production problems will exist, time and effort will be lost, and materials wasted. Production planning and control can be viewed as the nervous system of a production operation.

PERFORMANCE OBJECTIVE (Suggested Time: 4 - 5 Days)

* TASK/COMPETENCY: (050). List and define the terminology associated with production control.

CONDITIONS: Students will be given a list of terms or meanings.

STANDARD OF PERFORMANCE: Define each term with 80 percent accuracy.

REFERENCES

TEACHER	STUDENT
1. Recommended a. Basic Manufacturing, Production Planning. Chapter 5, Pages 57-73. b. Exploring Manufacturing, Producing Products. Chapter 24, Pages 195-98.	1. Recommended a. Exploring Manufacturing, Producing Products. Chapter 24, Pages 195-98.
2. Suggested a. Basic Production Management, Operations Planning and Control.	2. Suggested a. Basic Manufacturing, Production Planning Chapter 5, Pages 57-73.

ACTIVITIES

TEACHER	STUDENT
1. Have students read the topic: Production Planning in recommended text.	1. Read the topic: Production Planning in recommended text.
2. Discuss the terminology of this area with students along with the overall function of production control.	2. Study the list of terms in suggested text.
	3. Participate in a discussion about the overall function of production control.
3. Hand out a performance quiz which deals with production control.	4. Take a performance quiz which will deal with production control.
4. Evaluate the results of performance quiz.	5. Turn the test in for evaluation.

PERFORMANCE OBJECTIVE (Suggested Time: 4 - 5 Days)

TASK/COMPETENCY: (051). Develop a timetable of scheduled events that must take place to have a successful enterprise.

CONDITIONS: Students will be given sample charts, product, and time restrictions placed by the school.

STANDARD OF PERFORMANCE: Complete the time schedule with 70 percent accuracy within the time restrictions of school.

REFERENCES

TEACHERS	STUDENTS
1. Recommended a. Basic Manufacturing, Scheduling, Gnatt Charts. Chapter 5, Pages 70-73. 2. Suggested a. Production-Operations Management.	1. Recommended a. Exploring Manufacturing, Producing Products. Chapter 24, Pages 195-98.

ACTIVITIES

TEACHER	STUDENT
1. Discuss the uses and symbols of a Gnatt Chart and/or Project Evaluation Review Technique (PERT).	1. Participate in a discussion about the uses and symbols of a scheduling chart.
2. Guide students in the development of either chart for the overall enterprise schedule.	2. Develop a chart for the overall schedule of activities for the company.
3. Have the students post the schedule in a location for everybody to track the progress of the company.	3. Post this chart so employees of the company can track the progress to profit.

PERFORMANCE OBJECTIVE (Suggested Time: 3 - 4 Days)

* TASK/COMPETENCY:(052). Develop a work order/route sheet.

CONDITIONS: Students will be given sample forms, sequence of operations, quantities required, destinations, and order numbers.

STANDARD OF PERFORMANCE: Complete the forms used for production of the enterprise's product with 80 percent accuracy.

ENABLING OBJECTIVE: Students must have an understanding of the terminology, activity, and machine capabilities.

REFERENCES

TEACHER	STUDENT
1. Recommended a. Basic Manufacturing, Production Planning. Chapter 5, Pages 57-73.	1. Recommended a. Exploring Manufacturing, Producing Products. Chapter 24, Pages 195-98.
2. Suggested a. Exploring Manufacturing, Producing Products. Chapter 24, Pages 195-98	2. Suggested a. Basic Manufacturing, Production Planning. Chapter 5, Pages 57-73.

ACTIVITIES

TEACHER	STUDENT
1. Hand out as many copies as needed of the blank forms that are attached.	1. After reviewing the blank form participate in a discussion on the proper method for completing the form.
2. Discuss the title block information along with demonstrating the sequence of properly completing the forms.	2. Work with the following: a) Manufacturing Engineer b) Plant Engineer c) Methods Engineer d) Production Control This will make the activity easier and more quickly completed.
3. Act as a guide for the manufacturing group, plant engineering group, methods engineering group, and production control group to develop a proper sequence of producing parts and identifying bottlenecks with machines.	3. Complete the blank form for every part that has to be manufactured in the school laboratory.
4. Observe the cooperation when the groups are working together.	4. Make sure that when given to an operator that there should be no questions. (Do Not assume anything).
5. Review the final copies to insure there are no conflicts.	

PERFORMANCE OBJECTIVE (Suggested Time: 2 - 4 Days)

* TASK/COMPETENCY: (053). Develop a flow process chart of the production process.

CONDITIONS: Students will be given product design, material handling system defined, and a blank form.

STANDARDS OF PERFORMANCE: Complete the forms with 70 percent accuracy according to the evaluation criteria.

ENABLING OBJECTIVE: Students must have an understanding of the process symbols, machine capacities of the laboratories, and capabilities of tooling available.

REFERENCES

TEACHER	STUDENT
1. Recommended a. Basic Manufacturing, Production Planning. Chapter 5, Pages 57-73.	1. Recommended a. Basic Manufacturing, Production Planning. Chapter 5, Pages 57-73.

ACTIVITIES

TEACHER	STUDENT
1. Hand out blank forms of a flow process chart	1. After reviewing the blank form, participate in a discussion about the proper method for completing the form.
2. Discuss the title block information along with a demonstration of the sequence of process of a typical part.	2. Complete the blank form for every part that has to be manufactured in the school laboratory.
3. Act as a guide for the following groups: a. manufacturing engineer b. plant engineer c. methods engineer d. production planner.	3. Production control manager will gather copies of each part flow process chart and combine them into a booklet to be evaluated by the instructor before production begins.
4. Evaluate the final copy for accuracy.	

EVALUATION CRITERIA: Check for the proper sequence of operations and movement of material. Also make sure there is no excessive amount of idle slots noted. Note the proper location of inspections.

METHODS ENGINEER'S FUNCTION

INTRODUCTION: The methods engineer is directly responsible to the production manager or a plant manager. Methods engineering may be applied to all forms of work activity. It focuses attention on analyzing the work methods used in performing a task, determining the most effective method, standardization of that method, and determining the standard times for performing tasks. Methods engineering greatly assists in managing and controlling the work activities of any occupation.

PERFORMANCE OBJECTIVE (Suggested Time: 1 - 2 Days).

* TASK/COMPETENCY: (054). List and define the terminology associated with Methods and Work Measurement.

CONDITIONS: Students will be given a list of terms or meanings.

STANDARD OF PERFORMANCE: Match the terms to meanings with 75 percent accuracy.

REFERENCES

TEACHER	STUDENT
1. Recommended a. Appendix "O" Methods Engineers. b. Basic Manufacturing, Time and Motion Study. Chapter 5, Page 70. 2. Suggested a. Exploring Manufacturing, Evaluating Performance. Chapter 23, Pages 186-187.	1. Recommended a. Appendix "O" Methods Engineers. b. Exploring Manufacturing, Evaluating Performance. Chapter 23, Pages 186-187.

ACTIVITIES

TEACHER	STUDENT
1. Have students read the topic Methods Engineers in Appendix "O".	1. Read the topic Methods Engineers in Appendix "O".
2. Discuss the introduction along with the terminology of this area.	2. Participate in a discussion about methods and time standards.
3. Distribute a performance quiz which deals with methods engineering.	3. Take a performance test which deals with methods engineering.
4. Have the student turn in the performance test for evaluation.	4. Turn the test in for evaluation.

PERFORMANCE OBJECTIVE (Suggested time: 2 - 3 Days).

* TASK/COMPETENCY:(055). Develop work station designs for the enterprise.

CONDITIONS: Students will be given a sample design sheet, and operations process chart.

STANDARD OF PERFORMANCE: Design a work station with 70 percent accuracy according to the sample design sheet.

ENABLING OBJECTIVE: Students must have an understanding of principles of methods and work station layout, along with safety practices.

REFERENCES

TEACHER	STUDENT
1. Recommended a. Appendix "O" Work Station Design. Pages 7-11. 2. Suggested a. Motion and Time Study, Design and Measurement of Work. Principles of Motion Study.	1. Recommended a. Appendix "O" Work Station Design. Pages 7-11.

ACTIVITIES

TEACHER	STUDENT
1. Hand out sample of work station design and discuss the contents of the form.	1. Participate in a discussion about work station design.
2. Guide the methods group through layout of work stations along with the plant engineering group.	2. As a group, work with the plant engineering group to develop work station layout with plant layout.
3. Have the group turn in a copy of the final work station layout for evaluation.	3. Hand in your final copy to the instructor.

PERFORMANCE OBJECTIVE (Suggested Time: 1 - 2 Days)

TASK/COMPETENCY: (056). List and describe the steps needed to perform a direct stopwatch time study.

CONDITIONS: Students will be given supplemental handouts, sample time study forms, and stopwatches.

STANDARD OF PERFORMANCE: Complete the proper blanks on a performance test with 70 percent accuracy.

REFERENCES

TEACHER	STUDENT
1. Recommended a. Appendix "O" Methods Engineers. 2. Suggested a. Motion and Time Study, Design and Measurement of Work. Time Study Sheets.	1. Recommended a. Appendix "O" Methods Engineers.

SELECTED AUDIOVISUAL MATERIALS

Overhead Transparency of a Time Study Sheet.

ACTIVITIES

TEACHER	STUDENT
1. Have students review the steps mentioned in the handout.	1. Review the handout which deals with the time study form.
2. Briefly discuss each step with the class as a whole using an overhead projector to go through an example.	2. Participate in the discussion about an example of the time study sheet form completed.
3. Have each student fill in a blank form as a take home quiz.	3. You will take a quiz on completing the time study sheet.
4. Evaluate the results of the quiz.	4. Return the quiz to the instructor for evaluation.

PERFORMANCE OBJECTIVE (Suggested Time: 5 - 6 Days)

TASK/COMPETENCY: (057). Perform a direct stopwatch time study on operations in the lab.

CONDITIONS: Students will be given production process charts, blank time study sheets, and stopwatches.

STANDARD OF PERFORMANCE: Properly complete the blank forms with 70 percent accuracy according to the evaluation criteria.

ENABLING OBJECTIVE: Students must have an understanding of the steps involved in completing the forms.

REFERENCES

TEACHER	STUDENT
1. Recommended a. Appendix "O" Methods Engineers. b. Basic Manufacturing, Time and Motion Study. Chapter 5, Page 70. 2. Suggested a. Motion and Time Study, Design and Measurement of Work.	1. Recommended a. Appendix "O" Methods Engineers. b. Exploring Manufacturing Evaluating Performance. Chapter 23, Pages 186-187. 2. Suggested a. Basic Manufacturing, Time and Motion Study. Chapter 5, Page 70.

ACTIVITIES

TEACHER	STUDENT
1. Review the basic steps in doing direct stopwatch time studies.	1. Perform a number of direct stopwatch time studies on operations in the laboratory.
2. Guide the methods engineer through a series of time studies in the lab.	
3. Evaluate the time study forms for completeness and accuracy of numbers.	2. Complete the forms with accuracy and neatness.
	3. Turn in the completed forms to the instructor upon completion or due date.

EVALUATION CRITERIA: Check the title block noting the operation being timed. Note the sketch of the workstation being timed. Check the elemental layout and the times of those elements. Check the standard time and allowance factors.

APPENDICES

APPENDIX "A"

MANUFACTURING SYSTEM

COURSE OUTLINE

I. ADMINISTRATIVE ASPECT OF MANUFACTURING.

A. MANAGEMENT OVERVIEW

1. Organizational Structure.
2. Types of Production.
3. Society and Manufacturing.
4. Basic Terminology.

B. PERSONNEL MANAGER

1. Job Descriptions.
2. Job Application.
3. Hiring Process.
4. Terminology of Personnel.

C. MARKETING MANAGER

1. Market Analysis and Planning.
2. Advertising.
3. Sales
4. Packaging.
5. Distribution.

NOTE: THESE AREAS MAY START AT THE SAME TIME AFTER THE OVERVIEW.

D. FINANCIAL MANAGER.

1. Sources of Financing.
2. Cost Associated With Manufacturing.

II. PREPRODUCTION PLANNING.

A. RESEARCH AND DEVELOPMENT.

1. Explore and Select product.
2. Build Prototypes.
3. Material Exploration.
4. Competitive Analysis.
5. Financial Analysis.
6. Sketches.
6. Material Specifications.

B. MATERIAL MANAGEMENT.

1. Material Estimating.
2. Requesting Materials.
3. Purchase Orders.
4. Receiving Reporting.

C. PLANT AND MANUFACTURING ENGINEERING.

1. Safety Programs.
2. Plant Layout.
3. Material Handling.
4. Jig and Fixture Planning.

D. QUALITY CONTROL DIVISION.

1. Work Order for Inspections.
2. Inspection Requirements.

E. METHODS ENGINEERING.

1. Work Station Layout.
2. Work Methods to Perform Job.
3. Operations Process Charts.
4. Flow Process Charts.

III. PRODUCTION PROCESS.

A. PRODUCTION CONTROL MANAGER.

1. Processes Review
2. Work Scheduling.
3. Work Orders.
4. Work Measurement Time Studies.
5. Quality Control Measurements.
6. Output of Product.
7. Delivery of Products.
8. Profit or Loss Distribution.

APPENDIX "B"

JOB DESCRIPTION

AND

SPECIFICATION

FORM

The following is an example of Job Description taken from the text entitled: Basic Manufacturing:

VICE-PRESIDENT OF MARKETING

QUALIFICATIONS:

1. Must have interest in and some knowledge of sales.
2. Must be able to type and have access to a typewriter.
3. Must have basic knowledge of factors of supply and demand
4. A knowledge of economics and marketing would be helpful.

DUTIES:

1. To become knowledgeable about the position by reading from many sources.
2. To develop a consumer survey and supervise its implementation.
3. To report the compiled results of the survey and project a forecast of potential sales.
4. To be responsible for having the sales campaign established.
5. To supervise the total sales program.
6. To work with advertising as required for the sales program.
7. To supervise the coordination of packaging and advertising activities to insure an adequate job of each.

APPENDIX "C"

Applying for a Job

Directions *Use this employment application to apply for a job in a class production activity or for practice in applying for a job. Fill it out carefully and neatly. This will show the employer (teacher) that you try to do good work.*

APPLICATION FOR EMPLOYMENT

General Information

Name _____ Age _____

Education

Name of school presently attending _____

Name of school last attended _____

Rate your school attendance ☐ Excellent ☐ Good ☐ Fair ☐ Poor

Experience

Describe any part-time or summer work experience you have had _____

_____

_____

Rate your experience with each of the following tools and processes.

Amount of Experience

Tools and Processes	None	Some	Much	Skill*
Hand Tools				
Drill press				
Jigsaw				
Band saw				
Table saw				
Sanders				
Router				
Electric drill				
Radial arm saw				
Metalworking lathe				

Tools and Processes	None	Some	Much	Skill*
Uniplane				
Spot welder				
Buffer				
Vacuum former				
Grinder				
Squaring shear				
Box and pan brake				
Spray painting				
Welding				
Metal Casting				

*Your employer (teacher) may ask you to demonstrate your skill with tools and processes. Only the employer should mark in this column.

Interests

Which of these tasks would you rather do? Choose one from each pair and place a check beside it.

EXAMPLE			
Ride a bike	☑	*or* ☐	*Walk*
Drill holes using the drill press	☐	or ☐	Cut wood using the band saw
Smooth metal using the grinder	☐	or ☐	Weld steel parts together
Use a router to cut decorative edges on wood	☐	or ☐	Smooth wood using a power sander
Polish plastic using a buffer	☐	or ☐	Heat and bend plastic parts
Bend sheet metal using a box and pan brake	☐	or ☐	Rivet sheet metal parts together
Nail wooden parts together	☐	or ☐	Use spray paint to finish products
Print packages using silk-screen printing	☐	or ☐	Glue product parts together
Cut and fold packages	☐	or ☐	Smooth wooden parts by hand-sanding
Lay out parts for cutting	☐	or ☐	Check size and shape of finished parts
Direct other workers	☐	or ☐	Deliver parts

Applicant's Signature _____ Date _____

Employer's use only

Completeness _____ Accuracy _____

Neatness _____ Test Score _____

Possible Job Assignments _____

Other Comments _____

APPENDIX "D"

EMPLOYEE

RECORDS

The personnel department should maintain accurate records on each employee. These records should include personal history, education, job experiences, technical skill, wage levels, years of seniority, and performance evaluations.

The information found in the employee's record may be used for promotion purposes, recommendations for new jobs, merit pay, wage increases, and job assignments based on skills.

CLASS WORK HOURS AND PRODUCTION HOURS.

The personnel manager has the responsibility of maintaining accurate records concerning work hours for each employee. For the student enterprise, records must be kept on total class work hours and production hours. Class work hours are determined by use of the time cards. Each employee has his/her own time card, and is responsible for correctly punching in and out each class day. The personnel manager must be sure each employee knows the proper way of filling out the time card. Regular or normal class hours are recorded on the right hand side of the card, and overtime, when properly approved, is recorded on the left hand side of the card. Credit for class hours should only be given for that time shown recorded on the time card.

Production hours are recorded on a production job sheet form. Each student will have his/her own production job sheet. When a student receives a production work order he/she should get the production job sheet and properly fill it in by putting down start time of the work order and finish time of the work order when complete.

WEEKLY REPORTS

The weekly report of the personnel manager will be submitted to the president. It will consist of giving total class hours and production work hours for each person in the class. Total class hours will be taken directly from time cards. Production work hours will be taken from the production job sheet. The report will be posted each week to allow all people to see their hours. The following format is an example:

ABC TIME, INC.

Personnel manager's report for week ending _____

Total possible class hours to date: __50____

Total possible class hours during week: __6____

Total possible production hours to date: __20____

Total possible production hours during week: __6____

	CLASS		PRODUCTION	
	HOURS THIS WEEK	TOTAL HOURS	HOURS THIS WEEK	TOTAL HOURS
John Smith	6	48	6	18
Joe Brooks	5	45	4	16
Bob James	6	50	6	29
Dan Russell	4	40	4	15
ETC.				

PERSONNEL POLICIES AND PROCEDURES

The policies and procedures of the personnel department should be in line and follow-up general company policies and procedures. However, they are directly aimed at employee, labor, and public relations. Remember policies are rules of action which serve as guidelines for the employees. Procedures are steps which should be followed to carry out routine tasks consistently. You are required to develop a set of policies and procedures for the personnel department.

Examples of personnel policies are:

It is the policy of ABC Time, Inc. that:

1. Wages will be determined by the actual work hours spent on the production line and recorded on the production job sheet.

2. All employees must call in or make prior arrangements if they cannot be in class.

3. Unexcused absences will be deducted from your total points possible for the class.

4. All employees are required to check in and out by using a time card.

5. Overtime must be approved prior to putting in the hours.

6. Approved overtime will be used to make up time missed due to unexcused absences.

Example of a personnel procedure is:

The grievance procedure for ABC Time, Inc. is:

1. Grievance must be in writing, and submitted to your immediate supervisor.

2. Immediate supervisor will make a decision.

3. If not satisfied with supervisor's decision, or after two days, the employee may submit the grievance, in writing, to the next level of management.

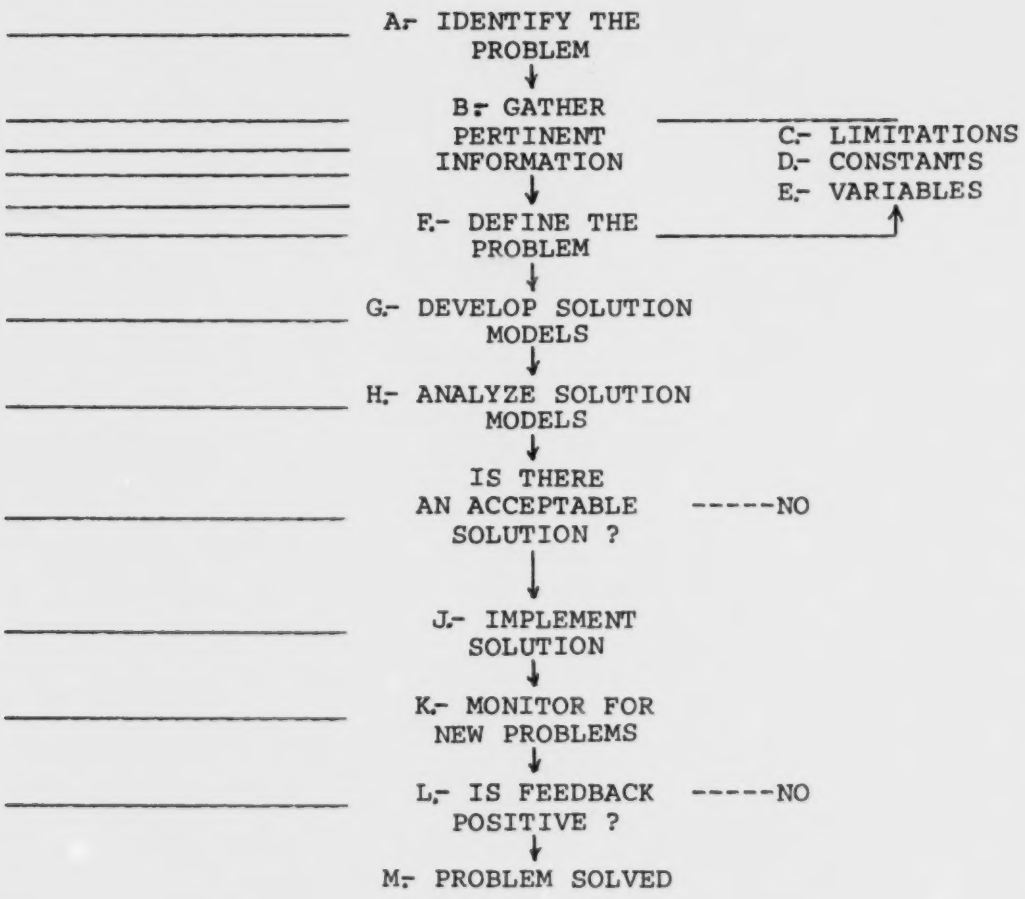
4. Next higher level of management will make a decision.

5. If the employee is not satisfied with the decision, or after two days, he or she may ask for a formal hearing with an arbitrator.

APPENDIX "E"

PROBLEM-SOLVING

MODEL



APPENDIX "F"

TYPES OF

RESEARCH

Research is the process of searching for unknown facts and principles. Research seeks new knowledge about materials, products, processes and consumer demand.

Pure research is done mainly to obtain new knowledge, with no practical use in mind. The information gained through pure research adds to the "knowledge bank" of the company or the nation. Eventually this information may lead to new materials or better products.

Applied research is used to solve specific problems, most companies conduct this type of research due to expense of pure research.

The third type is known as market research which purpose is to gather, record, and analyze facts regarding the potential marketing of the products of companies. Market research is very essential to product development and marketing decisions. Market research helps to identify the market target. The market target is the group of consumers toward which a company decides to direct its marketing efforts.

Market research is conducted in three ways. They are:

HISTORICAL RESEARCH - involves the use of sales records from past years. Most historical data must be modified to reflect present day economic conditions and changes in competition. Unless accurate sales records were kept in the past the data has limited use.

SURVEY RESEARCH - this involves contacting potential customers to gather information by use of a survey instrument or personal interview. Some surveys are taken by calling in a representative sampling of people by groups. The groups are then asked to react to various styles, designs, colors and other characteristics according to their performances.

EXPERIMENTAL RESEARCH - the product is introduced in a

test market. It is limited to use in a particular section of the country. The company can keep constant evaluation on the product such as how it is being received by the consumers. The test area should be similar to the larger market by representation so results will be accurate.

These are all ways in which products are developed and tested for acceptance in the market place.

APPENDIX "G"

SURVEY FORM

and

POLICIES

MARKETING POLICIES AND PROCEDURES

Policies are rules of action to help guide the marketing department in decision making. Procedures are series of steps necessary to carry out routine tasks. Both are important to the marketing function. Without policies pricing is difficult, whether to give discounts is questioned, how should orders be filled, what is the credit policy, and other questions are asked regarding routine tasks. The following are examples of marketing policy and procedure.

It is the marketing policy of XYZ, Inc., that:

1. Product prices are subject to change according to product cost.
2. Company employees will be permitted a 20% discount on the purchase of one product during a six month period of time.
3. A customer's down payment will be reimbursed if the customer is not satisfied with the final product.
4. All damaged products must be returned within 10 days of delivery, and only those with production defects will be exchanged.
5. A volume discount of 20% will be given for purchases of 10 or more products.
6. Credit will not be extended to any customer.

The following is an example of a marketing procedure.

Procedures for distribution will be:

1. Marketing will receive a written okay from production manager when products are ready for distribution.

2. Marketing will notify customers in order according to their pre-sales list to pick up their products at a specific location and time.
3. Products may be distributed by marketing personnel only or a representative appointed by the marketing manager.
4. Products will be left with a customer only if they have paid-in-full or pay balance upon delivery.

WEEKLY REPORTS

The marketing department will be required to turn in a weekly report to the president. This report will be due on Monday of each week. The weekly report will include an up-to-date summary of sales and distribution. The following is an example used:

XYZ, INC.

Marketing report for week ending _____

Previous Sales:

20 with $ 5.00 downpayment ----------
5 paid-in-full at $ 10.00 ----------

Sales This Week:

10 with $ 5.00 downpayment ----------
2 paid-in-full at $ 10.00 ----------

Number Distributed:

None to Date.

The figures found on the market manager's weekly report should correspond with the financial manager's weekly report regarding sales income for the week.

MARKET SURVEY

Date of Interview:_____

Interviewer:_____

Interviewee:_____

Interviewee's Address:_____

Complete the following form for the selected product

Personal Information:

1. Age

____ 5-10 ____ 11-15 ____ 16-20 ____ over 20

2. Sex

____ Male ____ Female

3. Marital Status

____ Married ____ Single

4. Education (Highest Completed)

____ Grade School ____ High School ____ College

5. Place of living

____ House ____ Mobile home ____ Duplex ____ Apartment

Market Information

6. Have you seen a similar product before?

---- Yes

---- No

7. If yes, Where?

---- In a store

---- On television

---- At a friend's house

---- Other (specify)

_____

8. Do you own a similar product?

---- Yes

---- No

9. If so, how long have you owned it?

---- Less than a year

---- 1 - 2 years

---- 3 - 5 years

---- over 5 years

10. Would you buy this product if it were available?

----- Yes

----- No

11. If yes, how much would you pay for it?

----- $ 0.50 - $ 2.00

----- $ 2.01 - $ 2.50

----- $ 2.51 - $ 4.00

----- $ 4.01 - $ 5.50

----- $ 5.51 - $ 7.00

----- Over $ 7.00

Product Information

12. Would you like the product to be:

----- A Light Color

----- A Dark Color

14. Would you like this product to be:

----- The size it is

----- Larger

----- Smaller

15. What changes would you like to see in the product design?
(Use another sheet for suggested changes please)

APPENDIX "H"

SOURCES

OF

FINANCING

Companies are constantly in need of money. Research and development of new products and processes must be financed. Equipment must be purchased. Materials and supplies must be purchased. Labor must be paid. Overhead expenses must be paid. Even before a company is formed it needs money to pay for license, corporation charter fees, attorney fees, and other legal fees.

Needs may be broken down as follows:

1) Fixed capital
2) Working capital.

FIXED CAPITAL

These are the funds needed to purchase property of a semi-permanent or permanent nature, such as land, equipment, buildings, and tooling. Fixed capital items usually cannot be converted into ready cash in a short period of time, if the cash is needed to pay bills or meet payrolls.

WORKING CAPITAL

These are the funds needed to cover the operating cost of the enterprise on a day-to-day basis, such as materials, supplies, and wages. Working capital appears in two forms:

1. Direct costs (variable costs) - expenses that may be specifically accounted for in the production of the products, such as materials.

2. Indirect cost (fixed costs) - expenses which remain relatively stable over a period of time such as taxes, rent, utilities, maintenance, and wages.

Our financial needs primarily are materials, supplies, some tooling, production wages, and overhead expenses.

QUANTITY

The quantity of funds relates to how much money does the enterprise need to operate. This is normally established by setting up budgets for the various departments. This is somewhat more difficult when you are just starting a company because you have no previous records to use as guidelines.

A budget is a financial statement of the estimated revenues (income) and expenditures (outgoing) for a definite period of time. Types of budgets to consider for the student enterprise would be:

R & D Budget - expenses for product prototype development and experimentation.

Marketing Budget - expenses needed for advertising, sales and distribution.

Administrative Budget - expenses needed to operate the office such as postage, supplies, travel, and reports.

Production Budget - expenses needed to cover overhead, tooling, and equipment.

Financial Budget - summarize the expected income and expenses for the budget period.

Budgeting helps determine what the selling price will be for the goods or services. It also determines estimated income and expenses so profit or loss can be calculated. These budgets should be worked out with each department. Money saved by each department may be turned into profit when the enterprise liquidates.

SOURCES

After determining the amount of money needed the financial manager, along with other company officers, must decide where the money will come from. Usually the source will be one which costs the least in terms of interest and time. There are three major sources of money, they are:

1. Equity (Owners' fund)
2. Debt
3. Revenue (Funds from sales or investments)

EQUITY- is obtained from the owners of the business. This money may come from sole proprietor, partners in the business, or shareholders in a corporation. All an owner has invested above and beyond all claims against him or her is considered equity.

If shares of stock are to be sold, it must be determined how much each share will sell for and how many shares will be issued. The number and value of each share to be sold must be listed in the cooperative articles of incorporation. An accurate record of all shareholders must be maintained by the financial manager on a stockholder record form. If stock is transferred this too must be kept on record so it is known to whom to pay dividends if a profit is declared for distribution.

If a sole proprietorship or partnership is established a record must be kept on the amount invested by the owner/owners, and how profits will be distributed.

DEBT- money received from debt financing is a loan. The company borrows money from some individual or a lending institution. Gaining money this way will cost the enterprise more because the company will likely have to pay interest on the amount borrowed. A company may go into debt by buying materials and equipment on time. This is similar to a short-term loan. You buy the materials from a supplier and the supplier gives you 30 days credit. This permits you to use the materials to make your product and hopefully you will be able to pay the debt off in 30 days. Within 30 days you may have your product sold which enables you to pay for the materials.

REVENUE- is money received by the enterprise through product sales, subsidies or donations. Primarily, it comes through sales of products. However, it cannot be looked at as a beginning source of finances because the product must be produced then sold. Some income from sales may come from down payments received from pre-sales orders. However, this money from down payments should not be relied upon to pay the company bills.

Remember your source of money does not have to be equal to the quantity of money to produce the products. Your initial amount is only for working capital, to get the business started. Your working capital should be almost equal to the amount of money needed to buy materials.

BREAK-EVEN ANALYSIS

A break-even chart graphically represents the relationships between the volume of production and sales with the amount of income and expenses. The break-even point occurs when sales revenue is equal to the total production cost. See the example of the break-even chart.

Sales = variable costs + fixed costs

To develop a break-even chart the following facts are needed:

1. Fixed costs - overhead expenses, labor, rent, utilities, general administrative expenses, etc.

2. Variable costs - materials.

3. Sales price per unit.

4. Number of planned products to be produced.

First, plot the fixed cost line. This line is a straight line because these costs are relatively stable, and represent costs which the company is obligated to pay. Production quantity has little effect on fixed costs unless additional personnel must be hired or additional shifts are added to meet production quantity.

Second, plot the variable cost line. This line starts where fixed costs are left off and is a diagonal line. For each new product that is produced it costs more in materials. With the fixed cost and variable cost plotted it can be determined the total production costs for any desired quantity of production.

Fixed cost + Variable cost = Production costs

The third line to plot is the sales income line. For each product sold the company gets a certain amount of income based on the selling price per unit. This line starts in the lower left corner of the break-even chart.

The break-even point occurs where the variable cost line and sales income line cross. By projecting this point straight down you can determine the break-even point in number of units produced. Projecting the point to the left you find the break-even point in dollars.

The wedge-shaped area between the variable cost line and sales income below the break-even point represents loss. The wedge above the break-even point represents the profit. The loss or profit can be calculated for any production quantity made and sold.

Profit may be increased by four methods. Each can be analyzed through the break-even chart.

1. Variable cost per unit decreased. The variable cost line is less steep, break-even point occurs quicker and profit wedge begins sooner.

2. Fixed cost decreased. The line is lower, and thus break-even point occurs sooner and profit wedge starts sooner.

3. Selling prices increased. Selling line is steeper, break-even point is lowered and profit wedge begins sooner.

4. Produce and sell more units. Does not affect the break-even point but does increase the width of the profit wedge.

The material manager, if he/she does the job of finding the best source and price for materials, can contribute a great deal to lowering cost per unit. Fixed cost can be decreased if departments maintain their budgets and carefully watch overhead expenses. Marketing must be careful about raising the selling price per unit because they may drop in sales or become uncompetitive with other companies selling similar products. Producing more products may not be possible within the facilities or time schedule.

The break-even point can be determined by formula. The formula is:

$$BEP = \frac{\text{Fixed Cost}}{\text{Selling Price per Unit} - \text{Variable cost per Unit}}$$

Selling Price per Unit = $ 8.00
Variable Cost per Unit = $ 3.50
Fixed Cost = $ 100.00

$$BEP = \frac{\$\ 100.00}{\$\ 8.00 - \$\ 3.50}$$

$$BEP = \frac{\$\ 100.00}{\$\ 4.50}$$

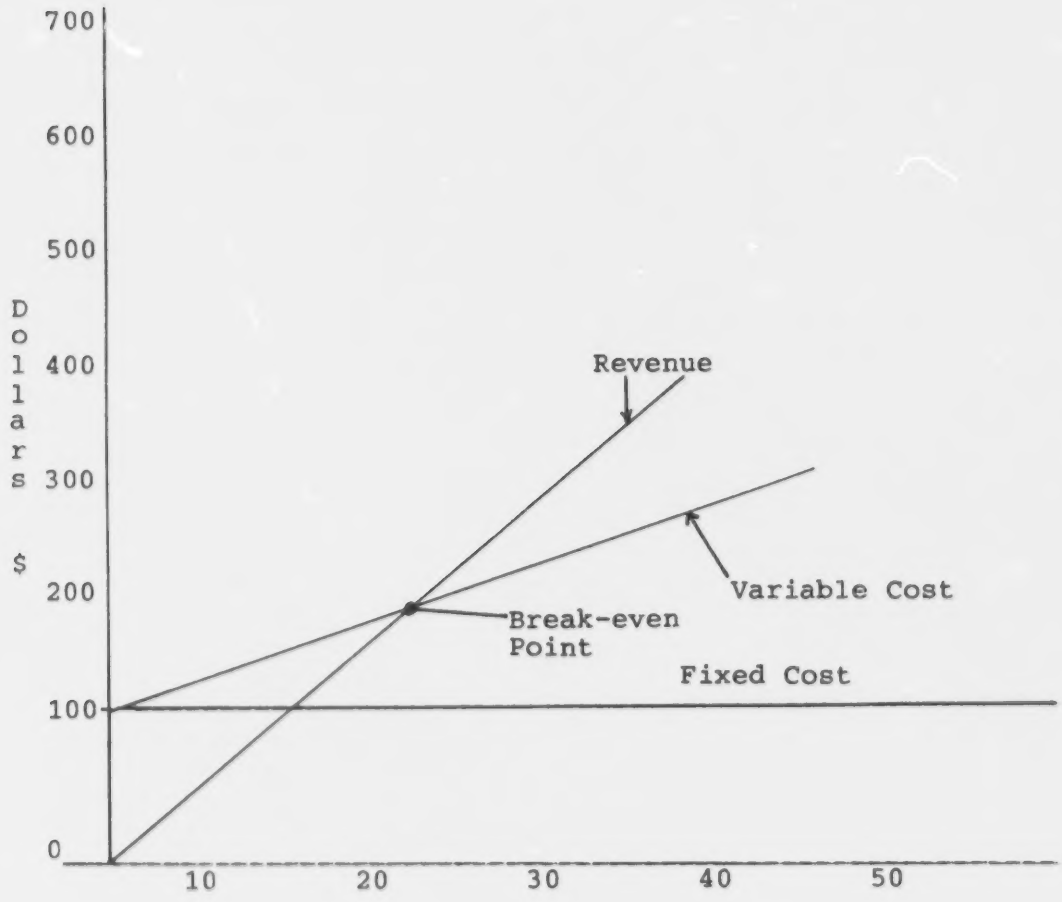
BEP = 22.2 UNITS

The break-even point in units is always rounded up. This means that on the sale of the 23rd product the company would make a slight profit.

BREAK-EVEN CHART

Product: _____ Date: _____

Sample Data: Fixed Cost ---------- $ 100.00
Variable Cost per Unit ---- $ 3.50
Selling Price per Unit ---- $ 8.00



FINANCIAL STATEMENTS EXAMPLE

ABC TIME, Inc.

Balance Sheet as of August 10, 1987

ASSETS:		LIABILITIES:	
Current Assets:		Current Liabilities:	
Cash	$	Accts. Payable	$
Acct Receivable		Notes Payable	
Inventory:			
Raw Material		Total Current Liab.	
In-Process			
Finished goods		Long Term Liabilities:	
Total Current Assets			
		Bank Mortgage	
Fixed Assets:		Total Long Term Liab.	
Equipment		NET WORTH (OWNERS' EQUITY)	
Total Fixed Assets		Preferred Stock	
Other Assets		Common Stock	
Total Other Assets		Total Owners' Equity	
TOTAL ASSETS	$	TOTAL LIABILITIES	$

ABC TIME, Inc.

INCOME STATEMENT

AUGUST 15, 1987

NET SALES ----------$

COST OF GOODS SOLD:

Materials----------
Labor----------

GROSS PROFIT (LOSS)----------$

Less: Operating Expenses:

Overhead Expense----------
Marketing Expense----------
Administrative Expense---------

Total Operating Expenses----------$

GROSS PROFIT (LOSS)----------$

Less: Depreciation----------

Net Operating Profit (Loss)----------

Add: Other Income:

Sales of Excess Material------

Gross Income----------

Less: Interest Expense----------

NET PROFIT BEFORE TAXES----------

Less: Federal Income Taxes----------

NET PROFIT----------$

WEEKLY REPORTS

ABC TIME, Inc.

Financial report for week ending August 14, 1987

Previous week Balance ----------$ 200.00

INCOME:

Sales -- 10 Products at $5.00 each down payment----------$ 50.00

NEW BALANCE----------$ 250.00

EXPENSES:

100 bd. ft. Walnut-------$	71.00
5 lbs. weldwood glue-----	6.95
Hardware----------	3.00

TOTAL EXPENSES----------$ 80.95

END OF WEEK BALANCE----------$ 169.05

BREAK-EVEN POINT

COMPUTER: Apple II

LANGUAGE: Applesoft

AUTHOR: Zeke Smolarek, UNI Grad. Student

APPLICATIONS: Manufacturing

INTRODUCTION: This program will plot a graph and print out (1) the number of units needed to be sold to break-even on a production run and (2) the amount of profit for a given number of units produced.

It should be used when students are preparing a manufacturing enterprise. They need to have the information described below in order to utilize the program.

On the average, a company works under these cost percentages: taxes 10%, rent 7%, wages and salaries 36%, production costs 25% and other costs 7%. This leaves about 7% for profit. Once the total product costs have been set, a break-even chart can be made.

The break-even point occurs when the company neither makes a profit nor loses money. The break-even point is found by following these steps:

1. Fixed costs include overhead, taxes, rent and general expense budget items. Fixed costs average 32% of the total costs. In our classroom we will use only a 5% average fixed cost factor.
2. Manufacturing cost per product are calculated by dividing material cost and labor by the number of products.
3. Sales income is figured on a per-product basis.
4. The break-even point is the point where manufacturing costs and sales income meet. The more units sold above this point the more profit earned by the company.
5. The total amount of money spent on wages, other costs and production costs is the fixed cost/unit . This is the point where manufacturing costs begin.

Reference: Iowa Industrial Arts Handbook for Introductory Level Production (Manufacturing and Construction) DPI, 1980 p. 478.

THE PROGRAM:

```
 1 REM ********************************
 2 REM * BREAK-EVEN POINT
 3 REM ********************************
 4 REM * PROGRAMMED BY ZEKE SMOLAREK
 5 REM ********************************
 6 REM * CALCULATES THE BREAK EVEN VOLUME
 7 REM * GIVEN THE COSTS AND PLOTS THE
 8 REM * COST RELATIONSHIP.
 9 REM ********************************
10 INPUT "SELLING PRICE/UNIT= ";SP
20 INPUT "VARIABLE COST /UNIT= ";VC
30 INPUT "FIXED COST IN TOTAL DOLLARS= ";FC
40 INPUT "EXPECTED VOLUME IN UNITS= ";EV
50 B=FC/(SP-VC)
51 REM ********************************
52 REM * DETERMINE THE Y SCALE
53 REM ********************************
60 J=EV/279
61 REM ********************************
62 REM * SET UP FOR GRAPHICS
63 REM ********************************
65 HGR
66 HCOLOR=7
67 HPLOT 0, 0 to 279, 0 to 279, 159 to 0, 159 to 0,0
70 FOR U=0 TO EV STEP J
80 Y = 159-(159*SP*U)/(SP*EV)
85 HCOLOR=1
90 HPLOT U/J,Y
100 Y = 159-(159*FC)/(SP*EV)
105 HCOLOR=5
110 HPLOT U/J,Y
120 Y = Y-(159*VC*U)/(SP*EV)
130 IF Y  0 THEN 140
132 PRINT "BREAK-EVEN CANNOT BE REACHED."
134 STOP
136 HCOLOR = 6
140 HPLOT U/J,Y
150 NEXT U
160 PRINT "BREAK-EVEN POINT = ";B;" UNITS."
170 P = (SP*EV)-FC-(VC*EV)
180 PRINT " PROFIT AT ";EV;" UNITS = $";P
185 END
```

APPENDIX "I"

BASIC

SAFETY

RULES

PROPER DRESS

1. Do not wear any loose clothing.
2. Do not wear long-sleeve shirts (roll sleeves above the elbow if you do).
3. Do not wear canvas shoes. They give no resistance to hard objects dropped on the feet.
4. Remove all rings, watches, bracelets, or hanging jewelry.
5. If you wear a tie, remove it.

SAFETY PROTECTION

1. Always wear safety glasses (goggles) in the lab.
2. If your work is noisy, wear hearing protectors.
3. Protect against inhaling noxious fumes.

LABORATORY MAINTENANCE AND CARE

1. Place all scrap in a scrap box.
2. Wipe up any fluid that has spilled.
3. Place all oily rags in a closed, metal container.
4. Keep aisles clear at all times.

LABORATORY ACTIVITIES

1. The lab is not a place for horseplay.
2. Most accidents are caused because simple rules were not observed.
3. Do Not "daydream" while working.
4. Assume all items to be sharp and/or hot, especially any metal scraps.
5. Be sure you have sufficient light to see clearly.
6. Never use compressed air to clean a work area; flying chips are dangerous.
7. Immediately inform the instructor of any cut, bruise, scratch, or burn - no matter how minor it may be.

APPENDIX "J"

TYPES

OF

PLANT LAYOUT

Plant layout is meant to provide a smooth flow of parts and sub-assemblies through the production sequence. This involves determining the best location of the equipment needed within the facilities. Space should be utilized as efficiently as possible. One goal is to provide a flow which reduces the distances the inputs must travel within the production system. The need for flexibilty in layout is of great importance. Usually the final layout is the result of a compromise among the many factors considered.

The plant engineer works with the methods engineer in determining the best plant layout. The reason for this is that the methods engineer is concerned with good work station design. The operation process chart is used to begin the plant layout.

There are four primary production layouts used in industry. They are:

1. Product layout.
2. Process layout.
3. Fixed position layout.
4. Cellular layout.

PRODUCT LAYOUT

This is a line type layout where the equipment is arranged to handle the step-by-step operational sequence required to produce the product. This is generally found in cases where the number of products are small, and these parts are highly standardized. They are also produced in large volume. Product layout is usually associated with a continuous or automated manufacturing system. Equipment is permanently arranged. Parts will move from one operation directly to the next with a minimum amount of movement required.

PROCESS LAYOUT

Machines are grouped according to the process they perform. This is sometimes referred to as a departmental layout. It is primarily used in intermittent manufacturing systems. It is probably the layout most frequently found. Process layout is characterized by low volume production, output nonstandardized, and a great deal of processing flexibility is required. General purpose machines are most frequently used in process layout. Transportation of material is generally the biggest problem in this type of layout.

FIXED POSITION LAYOUT

This type of layout allows the product to be produced at one site. The equipment and workers move to the site. Generally used where the product is quite large and moving would be impractical. Examples of fixed position would be in the construction industry or building an airplane or ship.

CELLUAR LAYOUT

This type of layout is new to industry and is composed of process layout modified where the machines are coupled together. Different machines are grouped together to finish a part completely without moving the part from department to department. All machines are usually computer-operated and controlled within each cell.

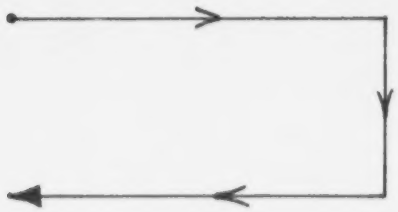
FLOW PATTERNS OF MATERIAL

STRAIGHT LINE

This pattern is geometrically sound because the shortest distance between two points is a straight line. For short production lines with only a few operations it could work nicely.

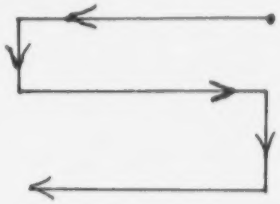
U-SHAPED

The U-shaped pattern makes use of a shorter space but does provide a long, smooth flow. It also has the advantage of developing the shipping and receiving department on the same end of the building.



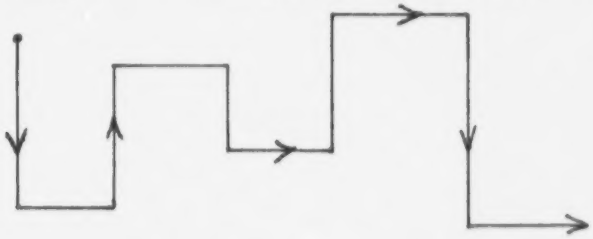
S-SHAPED

The S-shaped pattern may be used to shorten up the length due to the length of the building, but still gives good balance and a smooth flow.



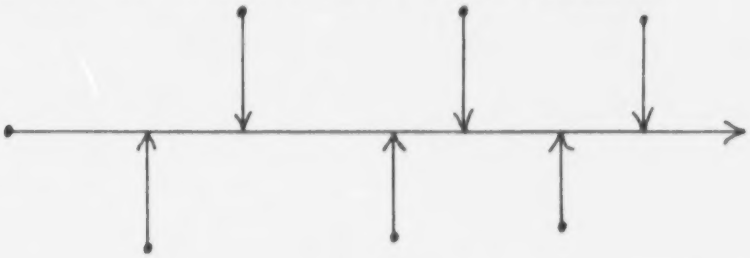
CONVOLUTED

The convoluted pattern takes on many turns and snakes its way through a facility. It allows for less length of the building but still gives smooth flow of materials and parts.



COMB

The comb pattern is generally found on assembly lines. Various parts and sub-assemblies enter the main assembly line where the product is put through final assembly.



APPENDIX "K"

MATERIALS REQUIREMENTS PLANNING

and

JUST-IN-TIME SYSTEM

CONCEPTS

In this appendix, we focus on the planning and controlling of manufacturing inventories such as raw materials, components, and subassemblies. The demand for these types of items is dependent on the amounts of finished goods that are scheduled to be produced and can be calculated from the forecasts of demand for the finished goods. A technique that can be used to manage the dependent-demand manufacturing inventories is called Materials Requirements Planning (MRP).

The philosophy of ordering component inventory depending upon the demand and production needs of other items is the approach followed by MRP. When operating properly, the MRP system will reduce inventory investment, improve work flow, reduce the shortage of materials and components, and help achieve more reliable delivery schedules.

INFORMATION FOR MRP

What makes the MRP process difficult is that many finished products consist of dozens or hundreds of parts, many of which are in turn dependent on other parts. Therefore, there must be accurate data and reliable computer information system to perform the many calculations that will be required for MRP. As a result, a computerized information system forms the basis for many successful MRP applications.

Materials Requirements Planning calculations begin with the MASTER PRODUCTION SCHEDULE which states the number of units of each finished product to be produced each time period. With the information in the master production schedule, we can begin to determine when the various parts or components that make-up the final products must be available. Thus, the next step will be to identify the list of parts that are required by the products. This information is available from the BILL OF MATERIALS (BOM), a structured parts list.

From the Bill of Materials, we can determine exactly how many components (parts) are needed in order to produce the quantity of finished products stated in the Master Production Schedule.

INPUTS:

The inputs to the MRP computation consist of forecasts or orders in developing a Master Production Schedule and also the Bills of Materials along with inventory status.

OUTPUTS:

The outputs from MRP computer program are the requirements or needs for each item in the Bill of Materials along with the dates each item is needed. This information is used to plan order release for production and purchasing.

CALCULATIONS:

The approach to determining net requirements whenever a dependent demand situation exists is:

Net Components Requirement	=	Gross Parts Requirements	- Scheduled Receipts Order Due	- Number of Parts on Hand Already

Where the gross requirement is the quantity of the component needed to support production at the next higher level of assembly. For example:

(We assume, for simplicity, that scheduled receipts are zero).

Quantity of snowblowers to be produced = 1250 units

Gross requirements, engines---------- = 1250 units
Less: engines in inventory---------- - 450 units
NET REQUIREMENTS, Engines---------- = 800 units

Gross requirements, air cleaners------ = 800 units
Less: air cleaners in inventory------- - 250
NET REQUIREMENTS, air cleaners-------- = 550 units
ETC. ETC. ETC.

While the net requirements for engines under the MRP approach is still 800 units, note how MRP has used the dependent-demand information to show that fewer air cleaners and filter housings will be needed.
NOTE: For the student enterprise scheduled receipts and inventory should be of little concern unless material is from past classes.

Until the development of large-scale computers, the sheer volume of calculations prohibited the implementation of an MRP system. The complexity involved in keeping track of the production and inventory status for every component can be appreciated for companies such as Ford Motor, John Deere, and General Electric.

JUST IN TIME DELIVERY

The JIT concept is part of MRP, but can stand alone as part of a concept in itself. JIT method is producing the necessary parts in the quantity needed at the time they are needed. Accomplishing the Just In Time objective rests on systems for determining production methods and the Kanban system. Both of these concepts contribute to the objective of having the right number of parts at the right place at the right time.

PRODUCTION METHODS

Production methods are less specialized, a worker may have the training to operate two or three different machines, thus providing flexibility in processes that precede the next work stations allowing for just in time delivery.

They also have developed standardized cycle times, routings, standard quantities for each process to establish quantities that can be produced per work station. There are various other methods that should be considered.

KANBAN SYSTEM

The simple Kanban system of inventory control is an integral part of the JIT system of production, and it has received a great deal of attention. The Kanban system is designed to produce only the number of units needed by a "PULL" or demand feeding process.

The beauty of the Kanban system is in its simplicity. A Kanban is a card of two types: A withdrawal Kanban (card) and a production-ordering Kanban (card). The withdrawal Kanban shows the quantity of the items that the subsequent process should withdraw from the preceding one. The production-ordering Kanban shows the quantity that the preceding process should produce. No complex record keeping is required.

APPENDIX "L"

POLICIES

AND

PROCEDURES

Policies and procedures are just as important for the materials manager as other departments in the company. They provide guidelines and rules of action so routine tasks can be done with less waste time and effort as well as being consistent. However, be sure people follow the policies and procedures. Put the policies and procedures in writing, and let them be known to all personnel.

Examples of policies for the materials management department would be:

It is the policy of materials management that:

1. ALL materials, equipment, parts, and supplies must be correctly requested through the proper line of authority.

2. ALL purchase requisitions must be correctly and completely filled out before they will be processed.

3. NO materials, equipment, parts, and supplies will be removed from inventory until approved by materials manager.

An example of a procedure for materials management is:

The procedure for requesting items:

1. Fill out, in triplicate, the purchase requisition form. (Be sure the specifications are clear and complete).

2. Have the request approved by your immediate supervisor.

3. Turn in request to materials manager.

4. When the request is approved, a copy of the request will be returned to you.

WEEKLY REPORTS

Weekly reports may be submitted to the president. It should summarize all requests for items needed, orders processed, and items received. The following format could be used:

ABC TIME, INC.
Materials manager's report for week ending _____

MATERIALS REQUESTED:

MATERIALS ORDERED:

MATERIALS RECEIVED:

APPENDIX "M"

SAMPLE OF

TOOLING DESIGN SHEET

The use of a jig and fixture design sheet permits the engineer to plan the tooling before he or she actually begins to build it. This saves time and materials. Trial and error methods should not be used.

With the design sheet the engineer can plan all the necessary information needed to build the tooling. The general information at the top is found by looking at the product and materials specifications, the product part drawings, and operation process charts. You are to sketch, isometrically, the tooling on the reverse side of the design sheet. This drawing should be complete with dimensions. Then figure out the materials and devices needed to build the jig or fixture. This information is placed on the front of the sheet. The engineer should then have the idea approved by the production manager.

When the jig or fixture is completed the engineer should test it for accuracy, using the same materials that will be used for the product part. After this check, give the design sheet and jig or fixture to the quality control department for final check according to specifications.

JIG AND/OR FIXTURE DESIGN SHEET

Designer's Name: _____ Date:_____

Product: _____ Part Name: _____

Drwg. No.:_____ Part No.:_____Operation No.:_____

Jig/Fixture No.:_____Machine:_____Tool:_____

Explain the function of the jig or fixture:

MATERIALS NEEDED TO BUILD THE JIG OR FIXTURE

QTY.	ITEM DESCRIPTION	DIMENSIONS	AVAILABLE	ORDERED	COST

APPROVALS NEEDED:

BEFORE YOU MAKE: _____ DATE:_____
Production Manager

AFTER YOU MAKE: _____ DATE:_____
Quality Control

* You are to sketch, isometrically, the jig or fixture on the back of this sheet. The drawing should be dimensioned and have any necessary specifications.

APPENDIX "N"

POSITION OF

QUALITY CONTROL

The role of quality control is to see that the product is designed and manufactured properly, and is reliable. Quality control entails a much broader outlook than inspections. Inspection is geared to accept or reject according to the specified standards. Quality control is directed towards future production rather than past production.

The following tasks are usually associated with quality control:

1. Quality and workmanship standards.
2. Inspection standards.
3. Sampling.
4. Testing and inspection.
5. In-progress gauging.
6. In-process control.
7. Defect prevention.

Quality control is sometimes referred to as quality assurance because it must assure the quality is designed into the product and assure that standards are being adhered to in production. A complete quality control program consists of three phases. They are:

1. Quality assurance.
2. Worker attitude (workmanship).
3. Inspection.

QUALITY ASSURANCE

Quality assurance begins in the product design stage. In order to assure consumers reliable products, a successful manufacturing company must make an effort to design and build quality into its products. Every department and every person in the company should contribute to the consumer product's functional quality.

Reliability engineering is a part of the quality assurance program. It is the process of determining, in the initial product planning stage, the quality level for product materials, including specifications and workmanship. Also, it is the probability of performing a specific function under given conditions for a specific period of time without failing.

Quality assurance carries into the operation process phase of the product planning. As the operational process sequence is planned the quality control personnel must determine where the operations are located. Inspection at these critical operations will insure that quality is being maintained according to specified standards. In many companies the quality control department has the authority to stop production.

WORKER ATTITUDE

Many quality problems in industry are directly related to poor worker attitude. The worker may not have pride in his or her work, or not care to closely check his/her own work.

Quality goals should be established and the workers encouraged to aim their efforts toward these goals. The workers must know what is to be expected of them. "What is considered a reject? What are the specified standards to be followed?"

A most important aspect in changing people's attitude toward their work performance is the recognition given for accomplishment and outstanding performance. Commendations and certificates for excellence of workmanship or for attendance are used by some companies. Others have photographs of individuals or work groups with outstanding performance to be used in company papers or news releases. Performance charts can be posted so employees can see if they or their department is meeting performance goals.

Operator inspection procedures should be well clarified before production begins. These instructions are a sequential listings of the things affecting quality that the employee will do or look for in his or her job routine. The instructions include statements indicating what the employee is to do if parts are out of specification or will not assemble as specified. They also include instructions as to what disposition is to be made of material or parts not meeting specifications. Instructions regarding inspection procedures should be placed on the production work orders. If the work station is to be a separate inspection operation there should be a special quality control work order which entails the instructions (see attached sample).

INSPECTION

Even though a good quality assurance program is implemented, workers will make mistakes and the product will not always meet all standards. Inspection, as a part of the quality control program, is a critical function in any manufacturing activity. Inspection is a three part program:

1. Inspection of incoming raw materials and purchased parts.
2. Inspection of work-in-process.
3. Inspection of finished goods.

The purpose of these inspections is to determine if the materials or purchased parts comply with the specifications set forth in the product plans. Raw materials and purchased parts should be inspected as soon as they are received from the supplier.

Work-in-process inspection points in the production sequence are planned during development of the operations process chart. Look for points where the dimension is critical, or the shape and size are critical to the fitting into a jig or fixture.

Finished products must be inspected before they are packaged for distribution to consumers. Many times this may be a performance check, surface finish, and final assembly inspection. This helps eliminate any cost of returning defective products and reduces customer dissatisfaction.

Another decision to be made by the quality control department regarding inspections is whether they are to be random or 100 percent. 100 percent inspections are costly because of the time it takes and usually done following processes where quality variance is high and human error high. Finished parts, which are entering the assembly process, should be 100 % inspected so products will not have to be disassembled. Random inspections are more common where processes are uniform or where testing might mar the product. Random inspections may be done by a floating quality control person or the machine operator.

The quality control department is concerned with two types of work orders that communicate to workers what they are to do. The production worker order and quality control work order. (See production worker order example in the production control section and see the sample of quality control work order in this section).

It is especially important that the first part of any operation after setup be checked by quality control before the operator continues. This information should be so stated on the production work order.

QUALITY CONTROL WORK ORDER

MACHINE/BENCH: BENCH # 10 INSPECTION NO.: # 6

PART NAME: SHELF PART NO.: # 3

DRWG. NO.: # 3 TOLERANCE: + 1/32"

INSPECT. GAUGE/INSTR.: VISUAL RANDOM:_____ 100% ___XX___

FINISHED DIMENSIONS, SHAPE, SURFACE, ETC.

3/4" x 5" x 6" KIDNEY SHAPE ACCORDING TO DRAWING.

MATERIAL SPECIFICATIONS:

WALNUT, # 1 COMMON, KILN DRY

3/4" x 5" x 6" Kidney shape.

INSPECTION PROCEDURES:

1. Visual inspection for good routered edge.
2. Check for smoothness, nicks, burn marks.
3. If acceptable, route to belt sander.
4. If reworkable, send back to router operation.
5. If rejected, send to salvage area for possible use for other parts or scrap if not useable.

INSPECTOR	DATE	NUMBER INSPECTED	NUMBER REJECTED	NUMBER REWORKABLE
1.				
2.				
3.				
4.				
5.				
6.				

APPROVED BY:_____ QUALITY CONTROL MANAGER

_____ PRODUCTION MANAGER

QUALITY CONTROL DESIGN SHEET

Quality control department is responsible for developing all gauges and instruments needed for inspection throughout the production line. The quality control design sheet is used where it is necessary to build a specific inspection gauge or instrument.

INSPECTION DURING PRODUCTION

Once a part has been inspected, a system must be devised to route the part to its proper location. There are four different routes the part may take:

1. It passes the inspection and is routed to the next processing station.

2. It fails inspection, but if the errors are corrected it can be used, so it is routed back to the original processing station or to a rework area.

3. It fails inspection, but may be used as material for some other part, so it is routed to salvage, which sorts it and sends it to a proper processing station.

4. It fails inspection and is waste, so it is routed to the scrap box.

Simple inspection tickets my be produced so the inspector only has to initial the form and write a brief reason for rejection. Rubber stamps, colored tags, or a carpenter's crayon may also be used to mark rejects, reworkables, or finished parts.

INSPECTION TICKET

INSPECTION STATION NO.: _____

INSPECTION DATE: _____

INSPECTOR'S INITIALS: _____

_____ O.K. ROUTE TO _____

_____ REWORK, ROUTE TO _____

_____ REJECT, ROUTE TO _____

REASON FOR REWORK OR REJECTION:

INSPECTION TAGS

REWORK

Directions: _____

_____

_____

_____

Signed_____

REJECT

Reason: _____

Signed_____

APPENDIX "O"

POSITION OF

METHODS ENGINEER

Methods engineering brings together two very distinct fields of study - motion study and time study. It is difficult to separate time and motion study because of their interrelationships.

Motion study, sometimes called work simplification, entails analyzing the operational sequence and the movements used by workers while performing their jobs.

Time study, sometimes called work measurement, involves determining how long it takes to perform each operation. Time standards must be established with due regard for the methods used. Acceptable time standards cannot be made without first making certain that an effective and desirable work method is being used. Time standards may then be used to determine rate of production, cost, incentive pay, and balancing a production sequence.

The basic philosophy of methods engineering recognizes there are usually numerous ways to perform any tasks, but with proper planning and analysis, one method is usually superior to the others. Methods engineering strives to reach two major goals. They are:

1. Increase Productivity.
2. Lower per unit cost.

OPERATION PROCESS CHART

One of the first production planning tasks the methods engineer becomes involved with is the developing of the operation process charts. The operation process chart is used to determine the best possible sequence of operations and inspections needed to produce the product. An operation process chart is developed for each part of the product to be fabricated and any assembly operations. Other important features of the chart are the material specifications, machine processes, and tooling required.

During the production planning stage the methods engineer should be critical of the production sequence. Be alert for operations which take too long, alternate operations which would be better, ways to eliminate some operations, ways to combine operations, and be sure each process can be done within the available facilities. The key to planning successful methods is by using a questioning approach when the operation process charts are being developed. Each element in the sequence is questioned as follows:

	WHAT	What is the purpose?
	HOW	How can it be done better?
WHY?	WHO	Who can best perform the job?
	WHERE	Where could it be done at a lower cost?
	WHEN	When should it be performed within the production sequence?

WORK STATION DESIGN

This task involves two areas of concentration, (1) plant layout and (2) work station layout. For a production line to work smoothly each operation must be efficiently designed so the work can be done with the least amount of effort and time which is practical. This takes coordination and cooperation with the plant engineer in the development of the overall plant layout. Materials and parts should be moved a minimum throughout the production line. Once an efficient plant layout is developed and approved, the methods engineer can begin concentrating on the individual work stations.

The operator must be able to have necessary materials and tools within easy reach. The operator should never have to reach across a moving part of a machine. Unnecessary moves and reaches should be eliminated where possible. Safety should always be considered when designing the work stations. To eliminate unnecessary movements two operators may be assigned to some operations such as, where one operator is feeding stock and another person is needed on the outfeed side of the machine.

It will be necessary for the methods engineer to know what type of material handling equipment will be used at each operation. This is where working closely with the plant engineer is important. You will need to know how much bench space will be needed for the storage and working process for each operation. The methods engineer must know how large the jigs and fixtures are going to be as well as how many will be

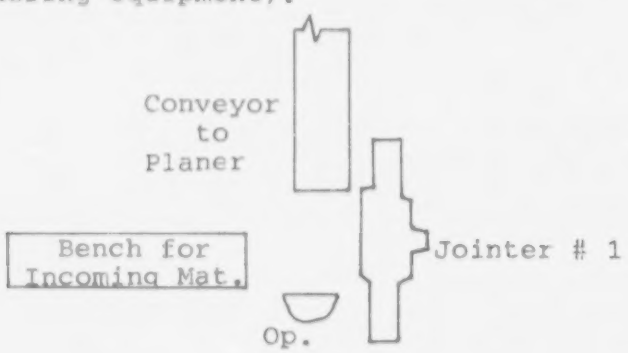
used at each operation so sufficient work space can be provided. This means working closely with the manufacturing engineers as they design and build the jigs and fixtures. Also knowing where the various machine controls are located is important to operator position.

In designing the work station the methods engineer should put themself in the position of the operator and completely simulate the operations. A work station design sheet will help the operators set-up the work center as it was designed for efficiency. Examples of other work station design might appear as follows:

WORK STATION DESIGN

Operation No.: 0-2 Part Name: Sides, Ends, Base
Machine: Jointer # 1 Part No.: # 1 , # 2 , # 3
Bench No.: N/A No. of Operators Needed: 1
Description of Operation: Operator to check each piece for cup warp. Put cup warp surface down and joint flat. Then place jointed face against fence and smooth one edge. place on conveyor to planer operation.
Scale: 1/4" = 1'-0" Drawn By:

Layout of work center : (includes machine, benches, operator/operators position, tools, jigs or fixtures and material handling equipment).



Hand sanding, bench finishing, sub-assembly, or final assembly benches will have to be laid out so parts move progressively along the line from one worker to another.

After the production actually begins the methods engineer should check to see that the design is being followed and if it is efficient from a standpoint of time and effort. If the work station design needs to be changed a new design sheet should be drawn to replace the old design sheet.

MOTION ANALYSIS

After production begins the methods engineer must make a motion analysis of operations being performed in the production sequence. This is done to see that the work station design is alright and that the operator is using good motion while doing the job. This becomes an operator process or left-hand/right-hand analysis. An operator process or left-hand/right-hand chart is used to record the motions of the operator.

The engineer observes the operator carefully as the operation is being performed. The procedure to follow is as follows:

1. Observe the total operation so as to familiarize yourself with the sequence of movements.

2. Observe and record the motions used by one hand.

3. Observe and record the motions used by the other hand.

4. Review the total process so you have recorded them properly as to the left-hand motions being performed at the same time the right-hand motions are being performed. If one hand is holding at the same time the other is closing a clamp, this should be recorded directly opposite each other on the chart.

TIME STUDY

The actual taking of a time study is both an art and a science. The time study analyst must be trained to perform the various procedures necessary in carrying out a complete time study. The time study procedure uses a systematic series of steps which will permit the analyst to efficiently approach any time study problem.

Time studies may be done by several methods based on labor and management agreements. Some union contracts do not allow stopwatches on the production floor for establishing the time standards. When this is the case, other methods will have to be used to determine time standards.

A. May have to estimate times by SIMULATION of the operation on a computer.
B. May use PREDETERMINED TIME SYSTEMS which give times for performing basic movements such as reach, grasp, move, position, turn, apply pressure, and release.

C. May use WORK SAMPLING--a sampling of production rate over a certain period of time, usually a week or more. Number of samples will determine the accuracy of the time standard.

D. Another method of taking times is through a direct stopwatch time study. Here you are concerned with getting a time for each element, but not the individual hands. A standard time can be determined for the total operation. A Standard Time is the amount of time required, under certain standard procedures to complete a task, taking into consideration the performance rating and allowance factors. Performance Rating system is below average (90%), average (100%), and above average (110%). Allowance Factors are classified as unavoidable delays and other interruptions which the operator has no control over during a 40-hour work week.

DIRECT STOPWATCH DETAILS

The operation is broken into elemental tasks by combining what the left-hand and right-hand are doing simultaneously. Here you are not concerned with idle time but merely the operational aspects needed to carry out the procedure. The following would be the breakdown into elements for the radial saw operation which was performed:

1. Get board from cart.
2. Place board in position for cutting.
3. Cut board to length.
4. Get cut board.
5. Place cut board on cart.
6. Get remaining board on bench.
7. Place board in position for cutting.
8. Cut board to length.
9. Get cut board.
10. Place cut board on cart.
11. Get scrap board.
12. Place scrap board on cart.

See the attached sample time study sheet for format of this sequence of operations.

Again it is not so critical as to when one element stops and the next begins as it is to be consistent with the stop and start points throughout the timing of each cycle. The time study form is used to record the times of each element for ten cycles, record general information, and calculate the standard time for the operation. The TOP SECTION of the time study sheet is used to record general information about the operation. The CENTER SECTION is used to breakdown the operation into its various elements and to record the times

of each element during the cycles. Whenever possible you should time the elements for at least ten cycles to obtain accurate times. After all cycles are timed the average for each element is calculated and recorded in the proper column. The average is gotten by taking the total time of the cycles and dividing it by the number of cycles observed.

The FOREIGN ELEMENT section is for recording notes concerned with unusual happenings or times during a cycle. For example, in cycle # 7 and element # 8 there is the letter "A". This refers you to the foreign element section. Here a note was recorded that tells why that time is slightly off from the other readings.

The LEVELING FACTOR SECTION is for rating the performance of the worker. Factor which should be considered for rating are (1) different skill levels of workers, (2) effort of the worker, (3) conditions of the work area, and (4) consistency of the movements. A worker may be judged by the observer as below average, average, or above average. When the average time is adjusted for performance the result is called the normal time.

The ALLOWANCE SECTION such as fatigue, personal, delays, and special circumstances are considered also in order to provide a more realistic standard time. This allowance factor usually is 5 to 20 percent. Most companies use 15 percent as an allowance. Normal time adjusted by the allowance factor results in what is called standard time.

The REMARK SECTION on the time study sheet is for the observer to mark down any unusual happenings such as number of pieces produced during the cycle or changes which might be suggested in the methods.

The PRODUCTION RATE for this example in the time study sheet would be calculated by the following:

$$\text{Production Rate} = \frac{\text{Work Time}}{\text{Standard Time}}$$

If the worker put in an eight hour day or 480 minutes, and the standard time was .830 you would have the following:

$$\text{Production Rate} = \frac{480 \text{ min.}}{.830} = 578.3 \text{ pcs. per day}$$

But remember the operator had cut 2 boards each cycle, as was noted in the remark section of the time study sheet. So the production rate would be 578.3 x 2 = 1156.6 pcs per day.

TIME STUDY SHEET

OBSERVER'S NAME: _____ DATE: _____
OPERATOR'S NAME: _____ OPERATION NO.: ____
PART NAME: _____ PART NO.: _____
MACHINE OR BENCH OPERATION:

ELEMENTS											
1. Get bd. from cart	13	12	11	12	13	14	12	13	14	12	.123
2. Place bd. for cutting	10	11	9	11	10	10	11	12	10	11	.105
3. Cut bd. to length	5	6	6	7	5	6	6	7	5	6	.059
4. Get cut board	3	3	4	3	2	4	3	4	3	3	.032
5. place cut bd. on cart	5	6	6	6	7	5	6	5	6	7	.059
6. Get remaining bd.	5	4	5	5	4	4	5	4	4	5	.045
7. Place bd. for cut	5	6	5	6	5	5	6	6	5	6	.055
8. Cut bd. to length	7	6	7	6	6	7	8A	7	6	7	.067
9. Get cut board	3	4	3	4	4	4	3	4	3	4	.036
10. Place cut bd. on cart	4	5	6	5	5	6	5	6	5	5	.052
11. Get scrap board	4	5	4	4	5	4	4	5	5	4	.044
12. Place scrap on cart	5	4	5	5	5	4	5	4	4	4	.045

FOREIGN ELEMENTS: A - Hit knot in board.

TOTAL TIME PER CYCLE .722

LEVELING FACTOR (PERFORMANCE):
Below average - 90 %
Average-------- 100 %
Above average-- 110%

RATING FACTOR 100%

ADJUSTED TIME .722

ALLOWANCE FACTOR: Fatigue Delay
Personal Use 15%

TOTAL ALLOWANCE 115%

STANDARD TIME .830

REMARKS: During this cycle 2 boards are cut.

***NOTE: Stopwatches usually for industrial purposes read in hundredths of a minute.

TIME STUDY SHEET

Operator _____ Date _____

Part Name and Number _____ Evaluator _____

Operation/s	Time Observations 1	2	3	4	5	6	Total Time	Average Time	Percentage Allowance	Standard Time

Example: When you know Average Time, Standard Time is figured as follows. (Assume that Average Time is 1.6 minutes and the percentage of Allowance is 5%.)

$$\text{Standard Time} = \text{Average Time} \times \frac{100}{100 - \text{percentage of allowance}}$$

$$\text{Standard Time} = 1.6 \times \frac{100}{100 - 5}$$

$$\text{Standard Time} = 1.6 \times \frac{100}{95}$$

$$\text{Standard Time} = 1.6 \times 1.05$$

$$\text{Standard Time} = 1.68 \text{ minutes}$$

PRODUCTION WORK ORDER

MACHINE/BENCH: Planer OPERATION NO.: 0-4

PART NAME: Shelf PART NO.: # 3

DRWG. NO.: # 3 NO. OF PCS.: 57

JIG/FIXTURE NO.: N/A TOOL TO BE USED: Knives

PREVIOUS WORK STATION: Jointer # 1

NEXT WORK STATION: Table Saw # 1

MATERIAL SPECIFICATIONS: FINISHED DIMENSIONS:

Walnut, #1 Common, Kiln Dry 3/4" x 6" x 18"
4/4 x 6" x 18" Rough on one
surface and edge.

DETAILED OPERATIONAL PROCEDURES:

1. Surface in blocks of 6 boards.
2. Measure thickness of boards and set surfacer for thickest measurement.
3. Make one full turn on table height for each cut until boards are 3/4" thickness.
4. Inspect thickness.

DETAILED QUALITY CONTROL PROCEDURES:

1. Inspect for 3/4" thickness.
2. Use go-no-go thickness gauge # 1.
3. Boards that will not go through planer due to warpage return to jointer.
4. Boards that become undersized send to salvage for use in other product parts.
5. Acceptable boards send to next station.

OPERATOR	DATE	NUMBER PRODUCED	NUMBER REJECTED
1.			
2.			
3.			
4.			
5.			
6.			
7.			

APPROVED BY:_____ PRODUCTION MGR.

_____ QUALITY CONTROL

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DEFINITION OF TERMINOLOGY

LIST OF TERMINOLOGY

MANUFACTURING OVERVIEW

ADMINISTRATOR--A person who carries out the decisions of a company's management.

ASSEMBLY LINE--A manufacturing process in which workers stay in place and parts move by them on a belt or track.

AUTOMATION--A way of making a machine or system operate without constant human control.

CAPITALISM--An economic system in which raw materials, factories and equipment, and finished products are owned by individuals and companies rather than by the government.

COMPANY--A group of people working together at a business, such as manufacturing.

COMPETITORS--Separate companies that make and sell the same products.

CONTROLLING--Insure that activities conform with the plans.

COTTAGE CRAFTS--Production work that people do in their homes.

CUSTOM PRODUCTION--A manufacturing method in which items are made one at a time and in which each item is different from the other.

DESCRIBE--To tell or write about something in detail.

DIRECTING--Actuate members of the group to carry out the assigned tasks.

ECONOMY--The system a nation or region uses to produce, buy, and sell goods and services.

END EFFECTOR--The "hand" of a robot used to perform tasks.

FACTORIES--Buildings in which goods are manufactured.

FREE ENTERPRISE--An economic system in which individuals are free to start nearly any kind of business they want.

INDUSTRY--A division of the economic institution which utilizes resources to produce products or perform services at a profit to its owners.

IMPORTED--Purchased from a foreign country and brought into one's own country.

INDUSTRIAL REVOLUTION--The period during which manufacturing began to take place in large factories instead of the home and during which engine-driven machines replaced hand tools.

INPUT-PROCESS-OUTPUT SYSTEM--Any system that produces a product or service (output) by working (processing) on or with inputs such as people, materials, information, machines, and money.

JOB LOT--A group of identical items made at the same time and in the same way.

JOB LOT PRODUCTION--A manufacturing method for making a limited number of identical items. Each item is made by several different people or shops, each of which makes one part of the product.

JOB SHOP--A place that does job-lot production.

LINE PRODUCTION--A manufacturing method in which the product moves slowly on a belt past workers as they work on the product.

MANAGEMENT--The part of a company that runs the company and makes its important decisions.

MANAGEMENT PERSONNEL--The people who run a company and make its important decisions.

MANUFACTURING INDUSTRY--The companies and people that make products.

MANUFACTURING TECHNOLOGISTS--People who are responsible for carrying out the plans of the manufacturing engineers.

MASS PRODUCTION--The manufacturing of large quantities of identical parts or products in a short time.

MICROCOMPUTER--A small computer designed for use in homes or in small businesses.

ORGANIZING-- Distribute work among the group and establish needed authority.

PATENTS--Protection granted by a government to an inventor to assure the inventor that his ideas or product will not be copied.

PILOT RUN--A test of a production line in order to discover problems before actual production begins.

PLANNING--Determine objectives and courses of action to be followed.

RECYCLING--Processing used products, such as old aluminum cans, so that they can be used in the manufacture of new products.

ROBOTS--Machines that automatically perform tasks that would otherwise be done by people.

STANDARD OF LIVING--The goods and services normally consumed by a particular person or group.

SUPPLY AND DEMAND--An economic principle stating that as more people want to buy a product (demand) more of that product will be produced (supply).

PERSONNEL MANAGER

APPLICATION--A form a worker fills out in order to apply for a job.

ATTITUDE--A way of acting that shows how a person is thinking or feeling.

COLLECTIVE BARGAINERS--Unions that try to work out an agreeement with management on behalf of all the workers.

FRINGE BENEFITS--Services such as paid vacations, pension plans, and health insurance provided by an employer for employees.

INCENTIVES--The reason for which one works or makes an effort. A paycheck is one incentive to work.

JOB INTERVIEW--A meeting between someone applying for a job and someone wanting to hire an employee.

JOB SPECIALIZATION--The practice of assigning a limited number of tasks to a worker so that the worker learns to do those tasks very well.

LABOR FORCE--The people who work.

LABOR UNIONS--Workers' organizations that try to get higher pay, shorter hours, and better working conditions.

LAID OFF--Dismissed from a job because there is no more work to be done.

LEGAL CONTRACT--An agreement recognized and enforced by law.

NEGOTIATE--To bargain (give and take) in hopes of reaching an agreement.

PAY SCALE--The standard rate of pay for a particular type of worker.

PERSISTENCE--The willingness to keep working at a difficult task in order to finish it.

PERSONNEL DEPARTMENT--The part of a company that keeps employee records and that often interviews and hires new employees.

QUALIFICATIONS--The training and experience that enable a worker to do a job.

REFERENCES--People who know a job applicant and will answer questions about his or her ability.

RETRAINED--Taught how to do a new job.

RETRIEVE--To look up information that has been previously stored.

UNION STEWARD--The union worker who often represents other union members in meetings with management.

WORK WEEK--The amount of time a person spends on the job during a single week.

PRODUCT DESIGN

APPEARANCE MOCK-UP--A model that looks just like a product, but has no working parts.

APPLIED RESEARCH--The process of finding new information in order to solve a specific problem.

ASSEMBLY DRAWINGS--Drawings that show the parts of an object and how they fit together.

BASIC RESEARCH--The process of finding new information before one has a specific use for the information.

BRAINSTORMING--A way to get ideas by listing every idea that comes to mind about a problem or product; sharing those ideas with others who are also sharing their ideas.

DESIGNING--The process of developing ideas, drawings, and models for new products.

DETAIL DRAWING--A complete drawing of a single part of an object.

DRAFTER--A person who uses designer's sketches and engineer's calculations to make the drawings needed to build a new product.

DUAL DIMENSIONED--Capable of being adjusted for metric or U.S. Customary measurements.

ENGINEERING--The process of planning, making, and testing new products so that they will perform exactly as they should.

EXPERIMENT--To test a new idea, process, material, or product to see how it works.

FORMULATE--To put together a new plan or idea.

HARD MOCK-UP--A model that is more accurate than an appearance mock-up. It is often made of the material to be used in the final product, but it does not have mechanical parts such as a motor or engine.

INTERACTIVE GRAPHICS--Computer program that enables engineers to try out plant layout before actually moving machines.

INVENTORS--People who create new products or greatly improve existing products.

MOCK-UP--Detailed models of a product.

PASTE-UP MOCK-UP--A rough, quickly made model of a product, often made of cardboard pieces pasted together.

PRINTS--Copies of a designer's final working drawings.

PRODUCIBILITY--The capability of being produced.

PRODUCT ANALYSIS--A careful examination of a product to see what is required to make it.

RENDERING--A neatly done, detailed designer's sketch made after rough sketches have been studied.

RESEARCH AND DEVELOPMENT--The processes used to find new ideas and turn them into successful products.

ROUGH SKETCHES--The second set of drawings done by a designer more detailed than thumbnail sketches but less complete than renderings.

SCHEMATIC DRAWINGS--Drawings of electrical and electronic circuits.

SKETCHES--Drawings used in designing a new product.

THREE DIMENSIONAL--Having height, width, and depth.

THUMBNAIL SKETCH--A small, quickly-done, drawing, in which designers first record ideas.

TWO-DIMENSIONAL--Having height and width.

WORKING DRAWINGS--Scale drawings of an object from which that object can be built.

MARKETING MANAGER

ADVERTISE--To let the public know that a product is available and to try to persuade the public to buy the product; to advertise is to let the public know that it has jobs available.

ADVERTISING AGENCY--A company that advertises the products of other companies.

COMMISSIONS--A part of the money taken in on sales that is paid to the person who made the sales.

CONSUMER--The person who uses a product.

CONSUMER DEMAND--The desire of people to own or buy a certain product.

CONSUMER SURVEYS--Questioning people about the products they use.

CROSS SECTION--A sample of people that includes men and women of different ages, incomes, education, regions, and so forth. All significant groups within the whole population are included in the sample.

DISTRIBUTION--Shipping new products to stores and consumers.

EXPORT MARKET--A market for one's products in foreign countries.

FACTORY OUTLETS--Places at which consumers can buy goods directly from the factory.

MARKET--The ability of a product to sell; the demand for a product.

MARKETING CHANNELS--The paths by which products move from producer to the consumer.

MARKETING DEPARTMENT--The part of a company that is in charge of advertising and selling a product.

MARKETING PLAN--A company's plan for advertising and selling a product.

MARKET RESEARCH--An attempt to find out what product people will buy, how much they will buy, and at what price.

MEDIA--Means of communication, such as newspapers, magazines, radio, and television.

PRODUCT SAMPLES--A small amount of some product or service that is used to test the product or to convince consumers to buy it.

PROMOTION--A company's plan to advertise and sell its product.

RETAIL OUTLETS--Stores that sell products to consumers.

RETAILERS--People or stores that sell products to consumers.

SALES FORECAST--A prediction of the future sales of a product.

SALES MANAGER--The person in charge of a company's sales department.

SALES REPRESENTATIVE--A person who tries to sell a product to others.

SELLING PRICE--Amount for which a product must be sold in order to cover total cost of producing it, plus profit.

TRADEMARK--Any word, group of words, or symbol that a marker or seller puts on a product to distinguish it from products made or sold by others.

UNIVERSAL PRODUCT CODE--System of lines used in the automatic identification of items.

WAREHOUSE--A building in which products are stored before they are shipped to consumers.

WHOLESALE OUTLET--A business that sells products to retail outlets.

WHOLESALER--A person or company that buys products from factories in large quantities and sells them to retailers in smaller quantities.

FINANCIAL MANAGER

ANNUAL REPORT--A booklet sent to the stockholders of a company every year to tell what took place in the company during the past year.

ANNUAL SALES--The total amount of money brought into a company by its sales during one year.

ARTICLES OF INCORPORATION--The legal document by which people apply to form a corporation.

ASSETS--Anything (such as land, buildings, equipment, cash) owned by a company

BANKRUPTCY--The state of being unable to pay one's debts.

BOARD OF DIRECTORS--The people elected by a company's stockholders to set policy and determine goals for the company.

BREAKING EVEN--A situation in which a company neither makes a profit nor suffers a loss.

CAPITAL--Money used to start and run a company.

CORPORATION--A company with some of the legal rights of a separate person.

COST ESTIMATOR--The person who tries to figure out how much money it will take to produce an item.

COSTS--Money that a company must pay out for the things it uses to make and sell its products; what a company pays for rent, the wages it pays to workers, and the money it pays for raw materials.

DEBTS--Money owed to other people or businesses.

DECLARED VALUE--The amount of money an owner says taxable goods are worth.

DIVIDEND--The portion of a company's profit paid to the stockholders.

FINANCIAL AFFAIRS--Any business relating to money.

FINANCIAL BACKING--The money needed to research, develop, and produce a new product.

FIXED COSTS--Costs, such as overhead, that cannot be lowered during the production process.

GROSS PROFIT--The total profit of a corporation before it has paid its taxes.

HEALTHY COMPANY--A company that consistently makes a profit.

INCOME--Money that comes into a company, usually from sale of its products.

INVESTED--To put money into a business with the hope of making a profit. The money is used to buy buildings or machinery, to pay workers, and for similar purposes.

KEEP (KEPT) THE BOOKS--To make and update records of all the financial dealings of a company.

LABOR COST--The cost of the time that workers spend making a product.

LOSS--A situation in which a company's costs are greater than its income.

MARKING UP--Raising the price of an item so that one can sell that item for more money than one bought it for.

MATERIAL COSTS--The cost of the raw materials and parts needed to produce an item

NET PROFIT--The profit of a corporation after taxes have been paid.

OVERHEAD--The costs of producing a product that are neither material nor labor costs.

PARTNERSHIP--A company that is not a corporation and that is owned by two or more people.

PROFIT--The money a company has left after selling its products and paying its expenses.

PROPRIETORSHIP--A business owned by one person.

REVENUE--The money that comes into a company; income.

SHARES--Units of stock, or ownership, of a corporation.

STOCK--The ownership of a company. Stock is usually divided into shares that can be bought and sold.

PLANT ENGINEERS

ASSEMBLY LINE--A manufacturing process in which workers stay in place and parts move by them on a belt or track.

AUTOMATED STORAGE AND RETRIEVAL SYSTEM--Computer-controlled method of moving items to storage and taking them out again.

AUTOMATIC GUIDED VEHICLE SYSTEM--Computer-operated industrial trucks.

COMBUSTIBLES--Materials that can catch fire and burn.

CONVEYORS-- Devices used to move materials over a fixed path.

CONVEYOR SYSTEM--Several conveyors connected one to another used to carry parts around a factory.

CRANE--A moveable hoist.

DOCKS--Special doors or ramps used for loading and unloading trucks or trains.

DYMAXION--A three-wheeled automobile designed by R. Buckminster Fuller.

FORKLIFTS--Small vehicles used to lift and move large stacks of material, parts, or finished products. Also known as industrial trucks.

HOIST--A lifting mechanism.

MACHINE GUARDS--Devices on power tools such as saws to protect the hands of the operator.

MATERIAL HANDLING--Moving raw materials and parts to where they are needed in a factory.

MATERIALS-HANDLING SYSTEM--The equipment used to move raw materials and parts to where they are needed in a factory.

OCCUPATIONAL SAFETY and HEALTH ADMINISTRATION (OSHA)--The federal agency that sets safety standards for the workplace.

PALLET--Low, flat platform on which parts or products are stacked.

PLANT LAYOUT--A plan that shows where machines and work stations will be placed in a factory.

SAFETY HAZARDS--Dangerous objects or situations.

SAFETY ZONE--An area marked off around a machine. When the machine is running, only the operator should be within the area.

MATERIAL MANAGERS

AUTOMATIC IDENTIFICATION--Computerized method of inventory control.

BAR CODING--System of lines used for product identification that can be read by a computer to keep track of items on hand.

INDUSTRIAL MATERIALS--Materials, such as steel, glass, nylon, lumber, and rubber, from which products are manufactured or constructed.

INVENTORY--A list of supplies in the plant and their locations.

INVENTORY CONTROL--The process of keeping track of all materials that are used by the company.

JUST IN TIME (JIT)--Ordering technique which provides for materials to arrive in the right amount just when needed for use.

LEAD TIME--The time needed between ordering supplies and receiving them.

MATERIAL COSTS--The cost of the raw materials and parts needed to produce an item.

MATERIAL REQUIREMENTS PLANNING (MRP)--Computerized method of estimating material needs.

MATERIALS MANAGER--Person in a manufacturing plant who is responsible for having the right materials in the right place at the right time in the right amount.

PARTS LIST--A list of exactly what parts are needed for a product.

PURCHASED PARTS--Parts bought from another manufacturer.

RAW MATERIALS--Natural materials, such as coal, iron ore, trees, cotton, and water, that can be used to manufacture products.

STANDARD STOCK--Materials, such as lumber or sheet metal, that have a widely-used size and shape.

PRODUCTION TOOLING

PRODUCTION TOOLING--Helps to hold, guide, and layout work so that it can be processed quickly and accurately.

FIXTURES--Are devices used to hold materials in place during drilling, shearing, sawing, and assembly operations.

JIGS--Are devices that serve two purposes: a) they are used to hold materials in place and b) to guide cutting tools into materials at the right locations.

TEMPLATES--Are patterns generally used during layout operations, used for marking desired shapes and hole locations on work materials.

GAUGES--Are used whenever the same dimensions must be measured over and over again.

PLUG GAUGE--Used to measure the diameter of a drilled of punched hole.

DEPTH GAUGE--Used to measure the depth of a drilled hole.

STOP BLOCK--A block of wood that is used to hold a board at a certain distance from the saw blade.

ASSEMBLED--Made of parts put together in a planned way.

EQUIPMENT--Large, permanently-based tools that are not run by motors.

FEASIBLE--Able to be done; possible.

QUALITY CONTROL--Those activities which prevent defective articles from being produced or, if they are produced, prevent them from reaching the market

INSPECTION--A test or examination of a part or product to find out if it has flaws.

IN-PROCESS INSPECTION--An examination of a product for flaws before production is complete during production and assembly.

SPECIFICATIONS--Detailed descriptions of the standards for materials, parts, and products. (i.e. size, kind of material, function, shape).

TOLERANCES--The amount of allowance one will accept beyond the specifications.

FINISHED GOODS INSPECTION--Assures that the products meet specification and works the way they are supposed to.

COMPLETE INSPECTION--(100 percent) that every part or product is inspected.

RANDOM SAMPLING--A small number of items is taken from a larger batch and tested. Parts are taken at random, that is, without particular pattern.

GC /NO-GO GAUGE--Special device required to measure the accuracy of parts, by slipping a part into the gauge.

INTERCHANGEABLE--Capable of being used in place of another, similar object.

DESTRUCTIVE TESTING--An inspection method in which samples of a product are destroyed in order to find their limits.

ACCEPTANCE ACTIVITIES--Inspecting raw material and parts to be used in production.
--Designing inspection devises.
--Inspecting gauges and tooling.
--Inspecting finished goods.

PREVENTION ACTIVITIES--Studying defect or rejection records.
--Training inspectors and employees.
--Examining customer complaints.

PRODUCTION CONTROL

PRODUCTION PLANNING AND CONTROL--Deals with planning and scheduling work so that the right materials reach the production line in the right amounts and at the right time.

FLOW CHARTS--Shows movement of materials for making all parts.

ROUTING--A plan for the procedures (steps) needed to make the parts and assembling of products.

OPERATION--Changing or working a material.

TRANSPORTATION--Moving a part from one place to another.

INSPECTION--Examining a part for quality.

STORAGE--Keeping a part safely until needed.

DELAY--Holding a part.

ROUTE SHEET--Plan of procedure is written for every part to be made by taking information from the flow process charts (does not show movement of parts).

SCHEDULING--Make sure that materials enter production at the right place and time.

DISPATCHING--The issuing of work orders to start production.

METHODS ENGINEERS

ALLOWANCE TIME--Time added to a work measurement time to allow for an occasional mistake or for slow workers.

DEBUGGING--Finding and correcting the small problems on a newly set up production line.

DIVISION OF LABOR--Breaking a complex job into a series of simple steps, each of which is performed by different workers.

EFFICIENCY EXPERTS--People who try to find ways to help workers work faster, do better jobs, and produce more.

FLOW CHART--A chart that uses standard symbols to show each step for producing an object and the order in which those steps take place.

FUNCTION--Purpose for which an item or system exists.

INTERCHANGEABLE--Capable of being used in place of another, similar object.

METHOD--A specific way of doing something.

PRODUCTIVITY--The speed and accuracy with which products are made.

TIME-AND-MOTION STUDIES--Studies designed to find the most efficient way of performing a task.

WORK MEASUREMENT--A determination of the amount of time needed to complete a task.

WORK STATION--The place in a factory at which a particular task is done.

APPENDIX "Q"

MANUFACTURING SYSTEMS

TOOLS AND EQUIPMENT LIST

1) 3 - 4 Workbenches with vises
2) 2 Wood Lathes (Numerically Controlled)
3) 1 Radial Arm Saw
4) 1 10 inch Table Saw
5) 2 8 inch Jointers
6) 1 Surfacer
7) 1 Band Saw
8) 2 Drill Presses (One Numerically Controlled)
9) 2 Plastic Strip Heaters
10) 1 Plastic Extruder
11) 1 Plastic Molding Machine
12) 2 Routers with various attachments
13) 2 Spray guns
14) 1 Grinding machine (Bench type)
15) 2 Mig Welding Machines
16) 1 Duplicator Machine
17) 1 Oxygen/Acetylene Cutting System
18) Various Hand measurement equipment
19) 2-4 Apple IIe Computers with printer
20) 1 IBM or Compatible Computer with printer
21) 3-4 Roller Conveyor line (8-10 ft. sections)
22) 4-6 Transport Carts (4 Wheel)
23) 6 Stopwatchers (1/1000 of minutes reading)

APPENDIX "R"

MANUFACTURING SYSTEMS

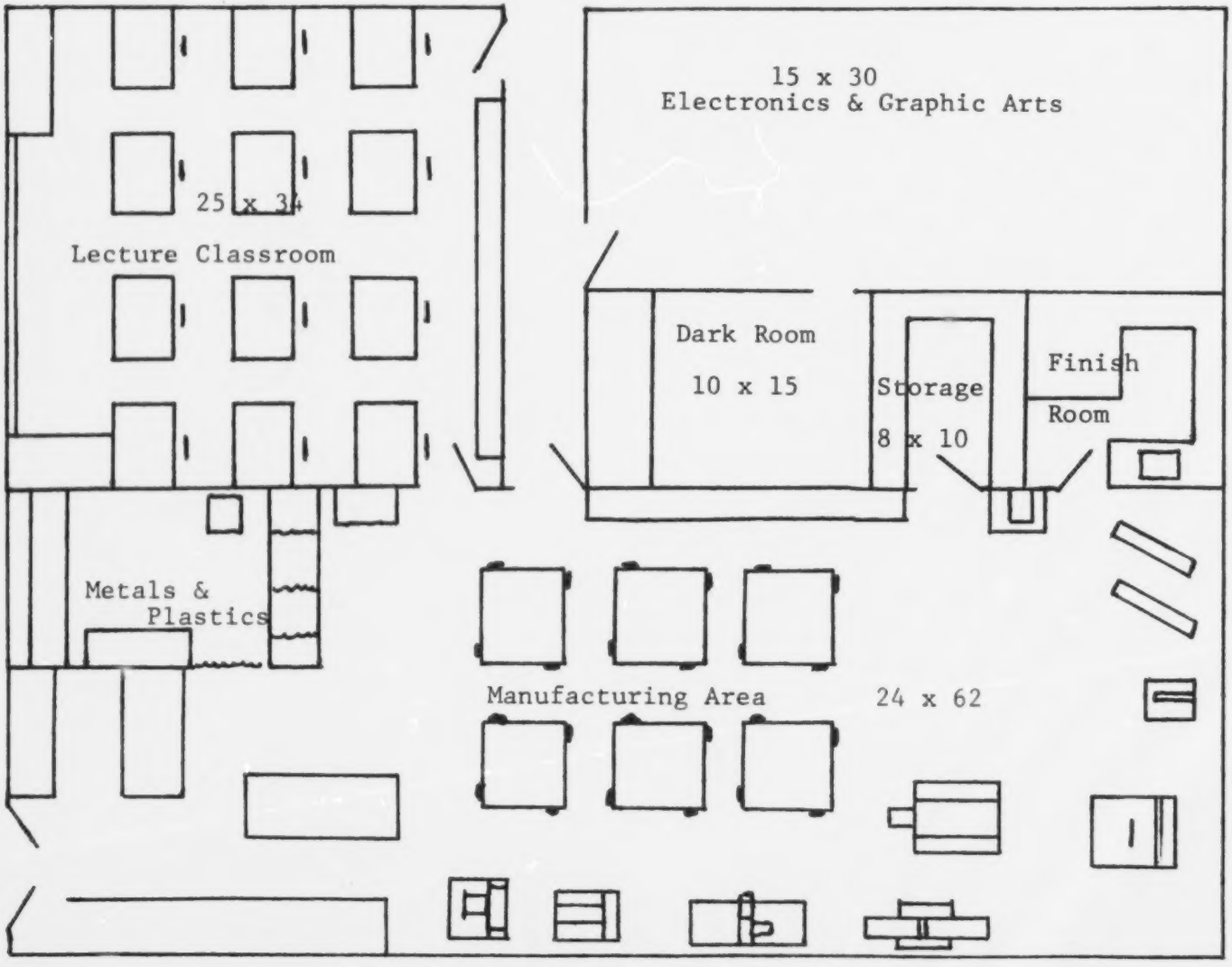
SUPPLY LIST

All supplies for this curriculum will be determined by the students upon the development of the product to be produced. This section is the responsibility of the materials manager working from the product design. Also the finance manager is to cover the cost of the materials required.

Schools may warehouse raw materials at their expense, but the class will select and purchase the material at the best possible price available.

The school may also inventory small sample finishing materials and small tools such as: saw blades, router bits, and replacement parts.

FOR EXAMPLE ONLY
(For detail specifications contact Industrial Education Unit)



APPENDIX "S"

Suggested Facility Layout for Manufacturing Systems.

BIBLIOGRAPHY

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Teacher Recommended Books

Fales, James, et al. Manufacturing: a basic text. Peoria, IL: Bennett and Mcknight, 1986.

Kruppa, Russell and Lindbeck, John. Basic Manufacturing Peoria, IL: Bennett and Mcknight, 1985.

Wright, Thomas. Exploring Manufacturing. South Holland, IL: Goodheart and Willcox Company, Inc. 1985.

Student Recommended Book

Wright, Thomas. Exploring Manufacturing. South Holland, IL. Goodheart and Willcox Company, Inc. 1985.

Reference Books

Apple, James. Plant Layout and Material Handling. New York: John Wiley and Sons, 1977.

Barnes, Ralph. Motion and Time Study, Design and Measurement of Work. New York: John Wiley and Sons, 1980.

Besterfield, Dale. Quality Control, A Practical Approach. Englewood Cliffs, N.J: Prentice Hall, 1979.

Buffa, Elwood. Basic Production Management. New York: John Wiley and Sons, 1971.

Frenzel, L.E. Crash Course in Microcomputers. Indianapolis, IN: Howard W. Sams, 1980.

Gunn, Thomas. Computer Applications in Manufacturing. New York: The Industrial Press, 1981.

Jambro, Donald. Introduction to Manufacturing. Albany, N.Y: Delmar Publishing, 1982.

Moore, Franklin. Manufacturing Management. Homewood, IL: Richard D. Irwin. 1961.

Niebel, Benjamin. Motion and Time Study. Homewood, IL: Richard D. Irwin, 1982.

Schmenner, Roger. Production-Operations Management. Chicago, IL: Science Research Associates, 1983.

Sullivan, George. How Do They Package It? Philadelphia, PA: Westminister Press, 1979.

Wight, Oliver. Production and Inventory Management in the Computer Age. New York: Van Nostrand Reinhold, 1984.

Audiovisual Resources

*** Filmstrips and Transparencies on Manufacturing.
Ball State University
Department of Industrial Education
Muncie, IN. 47306

Sound Filmstrips and Transparencies for Manufacturing.
McKnight Publishing Company
Dept. 584
Front and Brown Street
Riverside, N.J. 08075

Color Scund Filmstrip Machine Tool Safety
Prentice-Hall Media
ServCode CC
150 White Plains Rd.
Tarrytown, NY. 10591

Movie: The Industrial Worker; University of Illinois Film Center, Champaign, IL.

Movie: Industries of the Future; University of Illinois Film Center, Champaign, IL.

Movie: Man and the "Second" Industrial Revolution; University of Illinois Film Center, Champaign, IL.

Movie: People at Work: How Jobs Change; University of Illinois Film Center, Champaign, IL.

Movie: Career Goals; Bennett and McKnight Publishing Co. Peoria, IL.

NOTE: Asterisk is the needed audiovisual aid to do the course correctly.